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AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS

VOLUME XV MAY, 3, 1926 NUMBER 7

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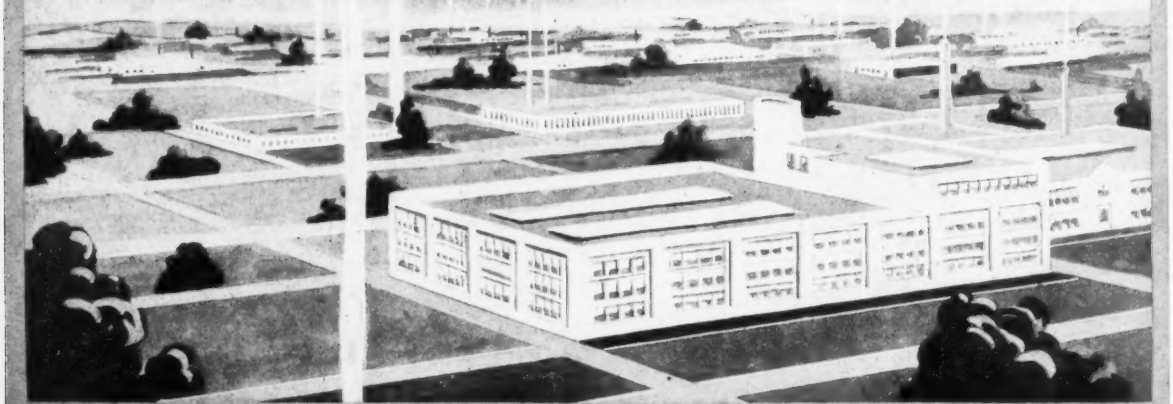

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Classification of Cotton by Microscopy

Microscopic Studies on Fibers—Seed to Cotton Ratio—Examination of Commercial Fabrics—Conclusions

By WILLIAM M. MEBANE and FRANK C. VILBRANDT

Department of Chemistry, University of North Carolina

COTTON fibers are the fruit of the cotton plant, and are subjected to the same fortunes and misfortunes, such as pests, frosts, underdevelopment, overripeness, etc., as other fruits. The degree of development, whether overripeness, underripeness, "dead," frost bitten, green, or for any other reason malformed must be expected to affect the general usefulness of the cotton as a textile. In this country in the classification of cotton little or no attention is directed toward its condition of growth other than length of fiber.

The classification of cotton according to growth condition of the plant has received some attention abroad. The classification of cotton as to its ripeness was first worked out by Crum[1], who pointed out that the condition of the fibers represented the age of the plant. He classified the fibers as green, half-ripe, and ripe. O. A. Mitchel and R. M. Prideaux[2] described green cotton as appearing flat, without indication of canal or lumen, with a thin outer membrane and lacking in tubular structure and twist; mature cotton as fully twisted with a thick and well defined wall; and "dead" cotton as a tube with hardly a perceptible twist, with little or no sign of the lumen. One type of the dead fiber is described as small, straight, and glassy, very much like the silk fiber. A. Herzog[3] observed that dead and unripe fibers are very much alike in that both have very thin cell walls and are not solid, and that they are about 35 per cent wider than mature fibers; they are transparent and the under wall shows through. Haller[4] described dead cotton as being ribbon shaped with many identations, distinctly striped, and granular in appearance.

As to the chemical conduct of the dead fiber Haller observed that ammoniacal cuprous oxide caused only a swelling of the fiber and that the identations disappeared; considerable time was required to dissolve the cotton, and very young fibers were not affected by this reagent. The fibers under treatment with 18 per cent NaOH swelled and became more transparent, causing the lumen and contents to disappear to some extent. One of the most important observations in relation to this work was that dead fibers are non-luminous in polarized light. "Dead" cotton has very little affinity for all dyestuffs except substantive dyes, the latter having a greater affinity for the dead than for the mature fibers. If dead cotton is mordanted with tarter emetic and tannin and dyed the cell walls only are dyed. The observations of Herzog (Loc. cit.) are the same with the exception that he claims that "dead" fibers only appear to have less affinity for dyes due to the lesser optical thickness. Examination of a large number of factory lots showed that those samples that failed to give a satisfactory luster on mercerization contained a relatively large amount of dead or unripe fibers, and that he could predict the result of mercerizing on a lot of cotton by examination of a relatively large number of the fibers of samples.

Much criticism and discrimination has been directed against upland cotton recently by foreign interests. It occurred that the basis for this discrimination may have been due to the dry weather that occurred during the growing season or to the rather non-uniformity of collection by the laborers and tenant farmers, introducing into the stock cotton a mixture of cotton subjected to all conditions of growth.

The object of this present study was to determine the effect of local and diversified conditions of picking on the growth condition of the fibers in the cotton by microscopic examination. Samples were collected from selected fields under varying weather and plant conditions. They were classified as unripe or green, ripe, overripe, and frost-bitten. The green samples were taken from bolls that were open just enough for the cotton to protrude slightly, or as well as could be judged, the condi-

[1] J. Chem. Soc. 10, 44 (1863).
[2] "Fibers Used in Textile and Allied Industries," Scott, Greenwood & Son, London, 1910.
[3] Chem. Ztg. 38, 1089-91. 1907-1100 (1914).
[4] Chem. Ztg. 32, 838.

tion at which it is open enough for the average cotton picker to collect it. The ripe samples were taken from bolls which were fully open, in prime condition, and in which the cotton stood out firmly, showing no signs of drooping. The overripe samples were taken from bolls

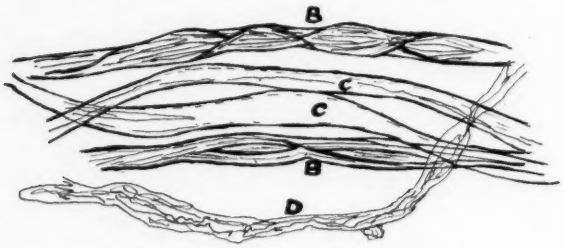

FIG. 1.—*Fibers in Green Cotton*

which had been open for some time and the cotton was drooping out and just ready to fall. All of these conditions were observed and the cotton collected in the fields before the pickers worked over them. The samples were taken from plants that appeared to be in the average condition of growth and health of the field, and the bolls were taken at random over the field, in order to get a representative sample of the entire field. The frost-bitten samples were collected after the first killing frost of the season, both from fully open and partly open bolls.

The samples were taken to the laboratory and stored in cotton bags in a well aired, dry room. After hand ginning the samples, slides were made in Canada balsam, and drawings of each were made with the aid of the camera lucida. Observations were made under the microscope with transmitted and reflected light, with crossed nicols and polarized light, chiefly to detect the dead and green fibers. The ratio of cotton to seed of each sample was obtained by hand ginning and weighing. The seeds were subjected to the "rag doll" test as recommended by the United States Department of Agriculture, to approximate the percentage of the seed that would germinate if planted. In addition several samples of domestic manufactured cotton goods were obtained from the local dry goods store for the growth condition analysis of the fibers and for observing the effect of dye on such fibers. These samples were chiefly from dress goods, and were made up of one to four colors of yarn. Samples were obtained of cotton flannel, denim, unbleached, and mercerized cloth. Slides were made of each sample and each kind of thread in them in Canada balsam and examined in the same manner as the field samples.

MICROSCOPIC STUDIES ON FIBERS

Following are some representative results obtained by microscopic examination of the various fibers collected:

Fig. 1 represents a typical example of the fibers obtained from the samples collected as "green." Each fiber drawn in the illustration was taken from one of the various samples collected, and is representative of the whole. "B" is the undeveloped or half-ripe fiber; it is not quite fully developed and the walls appear very thin; it appears dark brown under crossed nicols. "C" is the typical green fiber; it is thin and appears to have only two dimensions; under crossed nicols it appears black and under polarized light a watery whiteness. "D" is one from a sample that had dried in the boll when scarcely open. The fiber is not only dead or underdeveloped but shows distinct signs of decomposition. A survey of the slides showed that of the green cotton fibers 30 per cent were dead, 22 per cent were underdeveloped or half ripe, 32 per cent were green, and the remainder fully developed cotton.

Fig. 2 shows the average appearance of the type of cotton fibers that were obtained from the medium ripe samples. This sample was taken from a field at the start of the cotton picking season. It shows three types of fibers that were found in all the cotton samples examined. "B" represents the undeveloped or half ripe fibers; they are not dead but their growth was checked before maturity, and therefore the thickness of walls and development of twist is less than it would have been. "A" show the best type of fiber found; the walls are thick and give a strong play of colors under crossed nicols; the twist is highly developed. "E" shows the typical dead fiber; it is straight, glassy, and where bent shows a sharp angle. This fiber is white under polarized light and black under crossed nicols. The average of the samples examined showed that cotton taken under the conditions described as medium contains 25 per cent of "dead" cotton.

Fig. 3 represents characteristic fibers found in the samples collected as overripe. "a" is a fiber that appears

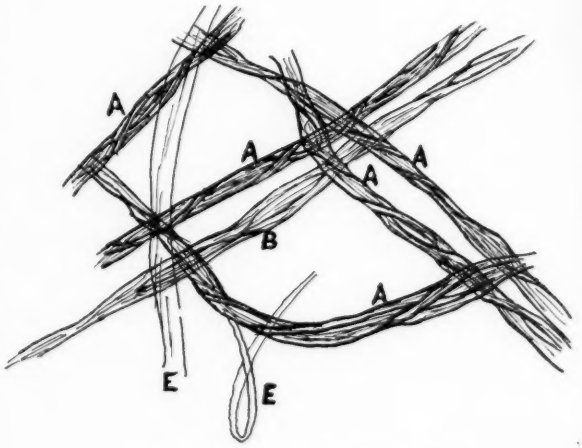

FIG. 2.—*Fibers in Medium Cotton*

to have a deficiency in the development of the walls. It is fully twisted but has no strong body lines, and shows black under crossed nicols. "b" appears to be a green fiber that not only was arrested in development but has begun to decompose. "c" is a normal fiber; a characteristic of the good fibers in these samples was that

they were more irregular in their twist than the others. "d" is a fiber that is apparently normal except that it has no twist, with only a few folds or wrinkles on its surface, but holding its tubular shape. "E" is the typical dead fiber of these samples. It may have the twist developed to some extent, but is dead and often shows signs of deterioration. "F" is a straight glassy tube which resembles silk fibers somewhat; it is found also in green samples. The overripe samples showed on the average 36 per cent dead fibers, 20 per cent underdeveloped, and the remainder fully developed.

The two drawings, Figs. 4 and 5, illustrate the two types of cotton found in the field after the first killing frost of the season. The first shows fibers from a mature boll, and consequently there was no difference between it

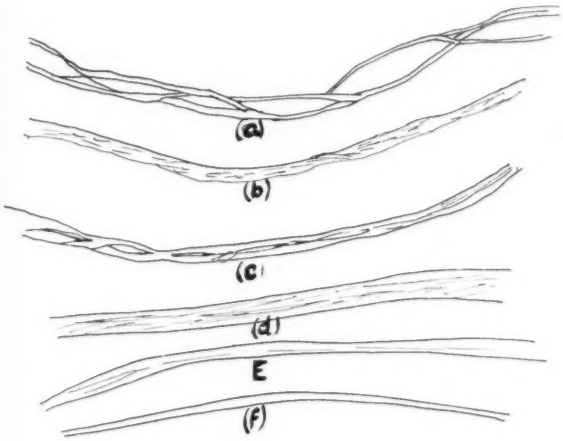

FIG. 3.—*Fibers in Overripe Cotton*

and another developed one. This condition showed the same percentage of poor fibers as the samples collected as medium. The cotton taken from partly open bolls showed about 75 per cent dead fiber. These are also the best examples of dead fibers. In the drawing "A-A" represent good fibers, and "E" the dead ones. This shows clearly the difference in width and general appearance of the two. "c" is a green fiber that is badly pitted and spotted.

SEED TO COTTON RATIO

The results of the determination of the ratio of seed to cotton, together with the percentage of the different types of fibers found in the samples from which they were taken, are given in Table I:

TABLE I

Type Cotton	Ratio Cotton/Seed	Rag Doll Test Per Cent Germination	Percentage of Growth Condition Fibers A Good Fibers	B Undeveloped or Half-Ripe	C Green Fibers	E Dead Fibers
Green	1/1.71	65.7	16	22	32	30
Medium	1/1.74	77.1	52	5	4	25
Over-ripe	1/1.83	76.1	47	20	0	36
After-frost ...	1/1.73	67.5	50	6	0	44

It is apparent that the weather and the time of picking directly influence the kind of fiber produced by the plant. In addition the ratio of cotton fiber to seed show a distinct relationship to the "rag doll" germination tests, either one representing an easy and distinct method of classifying cotton.

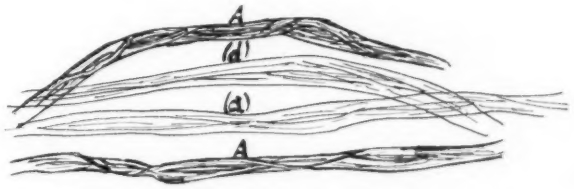

FIG. 4.—*After-Frost Cotton from Open Boll*

It is also apparent from the results that the great need of the cotton growers in the production of a better product is a classification according to the condition of the fibers as well as on the length. According to the results of these examinations the time to pick the cotton to get the best results is when the boll is wide open and the cotton is standing out firmly. This would, of course necessitate more frequent picking over the field but it would save a large percentage of the cotton which is both picked before ripe and that which is allowed to fall. The underdeveloped and dead cotton fibers are wasted when collected and woven into fabrics in which they do more harm than good. It is reasonable to expect that the cotton picked at the best time and properly classified should demand a price in proportion to the extra work required to produce it, because the examination of the products of some of our textile mills shows that there is need of adjustment somewhere. The fact that the European consumers of cotton are preferring other cotton to that grown in the South shows that there is something wrong with it, and it appears to be the large percentage of imperfect fibers that make it undesirable to those who wish to make high-class material from it.

The above examination of cotton for the condition of the fibers is not difficult. Herzog proved that he could predict the results of a mercerization by a microscopic

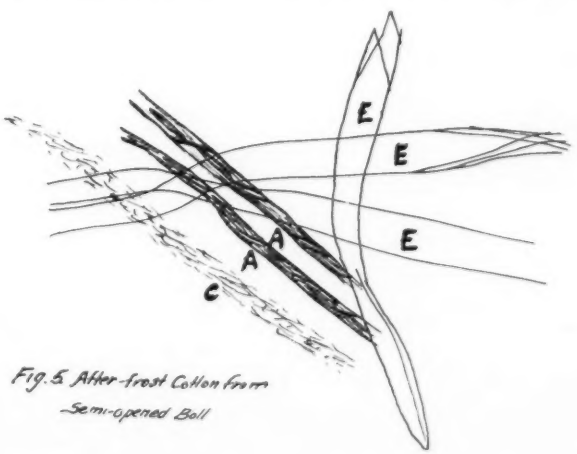

Fig. 5 After-frost Cotton from Semi-opened Boll

examination of the raw stock, and by such methods the finishers can judge the value of a yarn before they buy it. This method should prove invaluable to manufacturers of such type of cotton fabrics. The need for supervision of cotton picking is self evident.

Examination of Commercial Fabrics

In an effort to apply the information obtained by the microscopic methods on the cotton selected for study, samples of various commercial fabrics claimed to have been manufactured from native stock were obtained from the local dry goods store and examined to note any defects from the presence of dead or underdeveloped fibers. if such were present in the finished fabrics.

A sample of the fibers of a cotton handkerchief that had not been mercerized was examined. The examination showed 35 per cent of the fibers to be dead or badly underdeveloped.

Another sample of cotton which was mercerized was examined. It was found to contain dead and green fibers. The dead fibers showed no change in form from the process of mercerization, and the green ones were the same as before treatment, and but for their smaller size and smoothness looked very much like mercerized fibers. The imperfect fibers amounted to 25 per cent of the total.

A sample of yellow denim showed the dead fibers dyed brown, the good fibers yellow, and the green ones not dyed at all. About 25 per cent of the fibers were imperfect.

The examination of light unbleached domestic showed about 45 per cent imperfect. There were half-ripe, green, dead, and spotted fibers in the sample.

The examination of a black and white dress goods showed in the black portion the small green fibers dyed jet black, the thin ribbons of dead cotton a very pale black, and the fully developed cotton a medium shade. Crossed nicols showed dead fibers black, good ones pale spotted, and green ones light colored. The white or undyed portion of the fabric showed dead and undeveloped fibers.

A pink-colored cotton cloth contained about 15 per cent good cotton. The remainder was either green or dead. Only the good fibers were dyed a good pink color. The dead ones showed no color and the green ones were spotted with the dye to a slight extent.

A dress goods composed of interwoven black, pink and white threads contained a large number of fibers not dyed due to faulty application. Where the yarn was tightly twisted the dye did not penetrate. Of the pink only the dead fibers were dyed, and they were dark red. In the black only one in one hundred was dyed, and in the light black one in twenty-five. A low magnification was used to count a cross section of the threads and it was found that of the total only 33 per cent were dyed at all.

A sample of buff and blue dress goods appeared to come from unripe bolls. The fibers were all badly formed and many of them were dead. Of the blue portion 30 per cent were dyed. The dead fibers were slightly colored, and the green not at all. The fibers were all lacking in twist.

One of the results to be expected from the standardization of the quality of raw cotton is the production of a yarn that will dye evenly. One cannot get a full rich color to a fabric when only a small part of the fabric is dyed. The same applies to mercerization, because a dead fiber will not respond to the treatment that is given the textile to produce the smooth appearance.

According to P. G. Sanford[5], dead and undeveloped cotton is more reactive to nitration than fully developed fibers, and therefore the poorer or imperfect grades of cotton would be more useful in the cellulose industries that use cotton as a raw product for nitration than for textile manufacture.

There does not appear to be any use for green fiber, and there does not exist any reason for cotton to be picked from the boll in such a condition except the desire of the grower to reap all he can from the crop under the present system of classification, or the lassitude in collection of the cotton, the application of few and vigorous pickings of the field.

Conclusions

1. That the microscopic examination of cotton fibers a true classification of the value of fibers for textile discloses the growth conditions at the time of picking;
2. That microscopic classification of cotton fibers gives a true classification of the value of fibers for textile purposes;
3. That weight ratios of cotton to seed give an indication of the growth condition of the fiber;
4. That the "rag doll" germination of seed test gives a similar evaluation of the fiber;
5. That the growth condition of the fibers makes itself evident in finished fabrics both in the dyeing and chemical treatment of the fibers;
6. That the picking of cotton should be better supervised to increase the quality of the fiber collected.

[5] "Nitro Explosives," Crosby, Lockwood & Son.

The twenty-third annual convention of the American Leather Chemists Association is to be held at the Traymore Hotel, Atlantic City, June 2, 3 and 4. The program this year will include addresses by a number of very eminent authorities on subjects of interest to the leather trade. As always, the association is particularly desirous of having an many tanners present as possible. The convention last year was a very successful one and more than in previous years the tanners entered into the discussions. It is expected that this year will produce even greater activity of this most desirable nature.

Elimination of Waste in Bleachery Management

By W. L. CONRAD

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THE earnings of the finishing plant can be very materially increased by eliminating that part of the plant which does not contribute to these earnings. There comes a time in every industrial plant when the knowledge of the actual conditions within the plant is of incalculable value to the management. These conditions are not built up in a day, but are the results of sometimes years of use of accepted customs instead of established facts.

We believe it to be not only good, sound business practice, but the duty of those entrusted with the management of industrial institutions to build up and establish methods of production and control that will be beneficial both to the management of the plant and the operatives. Thus management and operatives will realize that they have much in common, and this knowledge will result in better economic conditions within the plant itself.

The savings you make, by the methods of manufacture you use, are actually so much net profit. If one of the departments of the finishing plant shows a profit over some other department, you have made a profit, just as apparent as if the profit had been realized through a sale of product.

There is no department in the finishing plant where there is more opportunity to effect a saving than in the bleach house. This is the most important department, and the savings effected here will reflect throughout the entire plant.

During the last few years the sentiment of the entire industry has been undergoing a decided change in this regard. Before that time, most textile manufacturers seemed to pay little attention to the bleach house and contented themselves with the knowledge that they had in their employ a bleacher who had years of experience and they "guessed" that he understood how to run the bleach house, and in many cases they did not dare to change his methods for fear that he would leave them. And this is actually the cause of the conditions we find to-day in many of the plants.

Conflicting ideas as to the methods used in the processing of cotton goods in the textile finishing establishments of this country have been the cause of a considerable amount of investigation on the part of those scientifically interested in the development of bleach house economics in an effort to secure, if possible, a more uniform method of finishing so as to eliminate much of the unnecessary waste which it is believed now exists in many of the bleach houses in this country.

The lack of scientifically secured information undoubtedly has been the cause of this evil which has been growing on us at an alarming rate, and there is a greater danger that the mere repetition of many of the customs which have grown up with this evil will cause them to be accepted as common practice.

Old Fashioned Practice Causes Waste

As an instance of the great amount of waste now prevalent in finishing plants, the writer found, in one plant where he was called to install modern methods of production, that this plant actually performed several more chemical operations than their competitors on the same line and quality of goods. When this matter was brought to the attention of the management, and they were shown the very large amount of money that was being spent yearly for these relatively needless operations, their only comment was, *"We have been accustomed to do the work this way since we started business, and it might interfere with the employees' regular routine if the methods were changed."* Evidently no thought had been or was being given to the economic or practical business side of this plant. And it may be said that this is not an uncommon experience, for we have found this same condition in a greater or lesser degree in many plants.

Another striking example of waste in this industry was brought to the writer's attention a few weeks ago. An old-established plant was preparing to build a modern bleach house and after carefully considering the most up-to-date and modern construction for the building itself they decided to install a method of manufacture which was entirely obsolete and had been practically discarded by the trade in general several years ago.

Every effort was made to induce the management of this plant to install modern, up to date and tested methods of manufacture, but although it was proven to them and they admitted that the modern methods would save them a large amount of money each year, still they decided to install antiquated methods, for by so doing they would not change the routine which they have been accustomed to and which their employees could follow without any great amount of supervision; in other words, it was following the line of least resistance.

Fortunately we do not find this condition of affairs prevalent in all cases, for in many of the new plants which have recently been built and many of the older plants in operation, modern methods of manufacture have

been installed which have materially reduced the manufacturing costs and greatly increased the output of these plants.

Importance of Scientific Management

It is believed that engineers who have given any considerable amount of study to the subject of bleach house economy will agree that a vast sum of money is being wasted each year. And that the greater part of this money can be saved by the textile finishing industry if the managers of that industry will co-operate with the scientifically trained bleach house engineers in an effort to eliminate the needless waste that is now going on in many of these plants.

Much is being done by organizations and by the Government to encourage the elimination of waste in industry, and we feel that much can be accomplished in the finishing industry by a systematic effort and the hearty co-operation of managers and engineers.

Automatic machinery has been installed to take the place of the hand labor formally so commonly used in the bleach houses, and the use of this machinery makes it possible to actually plan and operate the bleach house along predetermined lines.

It has been truly said that "It is the time spent on *keeping things running* that keeps most men from the big and constructive part of their jobs."

The word *manager* signifies one who controls or directs, but it is often used to designate the man at the head of the business, who is so dependent upon his foremen that he finds it impossible to do otherwise than as they wish

A properly managed plant is one in which all the operations are performed in accordance with well developed plans, and where nothing is left to the hasty judgment of anyone.

As usually conducted, nearly all of the operations in a bleach house and many other departments of the finishing plants, are liable to be changed by the foreman to suit what seems to him to be the necessities of the case, and as a result the finisher is often obliged to resort to extraordinary measures to get a uniform finish on goods bleached in an irregular manner.

Moreover, the ordinary method of the interrupted process, and of allowing the goods to remain in a bin or pile after each chemical operation and then drawing the goods from the top of the pile, is a most successful method of dividing each lot into several parts, and is usually the cause of uneven shade, which greatly increased the work of the finisher, and is also the cause of the broken lots and the uneven finish found in the shipping room.

Proper management requires that these irregularities be eliminated and that each lot of goods goes intact from the gray room to the finishing department by a prescribed route.

The operation of a bleachery in such a manner has been considered by many to be Utopian, and almost impossible of accomplishment. As a matter of fact, the only reason that the art of bleaching and finishing has not been put on the same basis as other scientifically regulated industries, is that it has not been given the same study by scientifically trained men, which has been accorded many other industrial processes.

The first step of such a bleaching process has been successfully taken, and there is now on the market a mechanism which enables one to give all the goods of a lot or number of lots identically the same treatment as it passes continuously from the gray room, or kier, through the bleach house to the white bins. Lots of goods thus come to the finisher uniform and complete, and whether the finish is white or colored, the shade is uniform from one end of the lot to the other. Moreover, if the goods progress through the various processes of bleaching and finishing according to a regular schedule, the manager can know at any time where any lot is, and make his promise of delivery accordingly.

This constitutes what may be termed "the first step in the proper regulation of processes in the finishing plant," and it is a well-known indisputable fact that unless the goods are properly treated in the bleach house any amount of expert finishing will fail to produce a satisfactorially manufactured product.

Years of experience in handling mechanical bleach house problems have developed valuable knowledge of the workings and shortcomings of this part of the industry, and it is the writer's opinion that with the wholehearted co-operation of trained bleach house engineers and the plant managers, much good may be accomplished for the industry as a whole and the individual plants in particular. For, granting that each plant has its particular problem, still, they have much in common; in fact, much more in common than most managers realize. And the properly trained bleach house engineers can accomplish a great deal if given the opportunity. Work of this kind is an insurance against problems, and you will find that the application of expert engineering knowledge is the *"Tremendous Trifle"* that will eliminate these production problems, and will bring about efficient operation of the plant and a materially reduced production cost.

This work need not be confined to the large and up-to-date plants. Many small, poorly designed, and what appeared to be almost impossible plants, have been transformed into maximum product and revenue producers by the installation of modern operating methods, and this with practically no change in location or buildings.

The success that has been achieved by engineers in treating practically every mechanical problem found in the bleaching industry has inspired us to place the knowledge we have acquired at the command of the industry, for we are confident that the equipment which we recommend will show a very large profit on the investment.

"Dyeing Acetate Silk" and "Acetate Silk —Its Dyes and Their Application"

A Collective Index Covering the Subjects, Authors and Patent Numbers as Published in the Above Two Series of Papers

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Production and Sales of American Dyes Increased in 1925

Exports and Imports Larger—Prices Declined

AN increase in dyestuff production in the United States of 25 per cent by quantity over that of 1924 has been announced by the United States Tarirff Commission. There was also an increase of nearly 22 per cent by quantity in sales over 1924 figures, and a 5 per cent increase in total value of sales.

Preliminary figures compiled by the Tariff Commission show a domestic production of coal tar dyes for the calendar year 1925 of about 86,000,000 pounds, with a value of about $40,000,000. The total sales of dyes in 1925 were about 79,000,000 pounds valued at $36,900,000. This increased output and sales is largely due to the greater activity of the domestic textile industry and an improvement in the export trade in Indigo and Sulphur Black.

The outstanding features for the year were (1) continued recessions in dye prices due largely to the severe competition between the domestic manufacturers; (2) conspicuous progress in the manufacture of fast dyes, many valuable dyes of high fastness being produced for the first time in the United States in 1925. The output of vat dyes (other than Indigo) exceeded 2,500,000 pounds, compared with 1,820,000 pounds in 1925. This class of dyes is used largely on cotton and yields shades of exceptional fastness. This increase is of special interest as indicative of the pronounced trend toward an increased use of fast dyes. (3) The imports of dyes recorded a 75 per cent increase, by quantity, and a 65 per cent increase by value. This increase in imports since the tariff reduction of 15 per cent on September 21, 1924, shows increased competition from foreign dyes, mostly of the higher cost types. (4) Dye exports recorded an increase amounting to 64 per cent by quantity and 19 per cent by value over that of 1924.

The weighted average price of all domestic dyes sold in 1925 was nearly 14 per cent less than the average of 1924. The following table shows the trend of the average prices of domestic coal tar dyes in recent years:

Year	Weighted average* sales price of domestic dyes.
1925	$0.466
1924	.54
1923	.545
1922	.60
1921	.83
1920	.99
1917	1.26

*The total value of all dyes divided by the total quantity.

The price recessions were of a general character and include the low as well as the high price dyes. The aver-

age sales price of indigo in 1925 was 15.5 cents per pound compared with 22 cents in 1924. The current price is about 12 cents per pound, a decrease from the pre-war price when our entire supply was imported from Germany and Switzerland.

Dye Imports Record Increase

The total dye imports during 1925 were 5,315,158 pounds with an invoice value of $4,791,900. This represents a 75 per cent increase by quantity and a 65 per cent increase by value over that of 1924. Since the tariff reduction, the imports have recorded a conspicuous increase. The average monthly import during during 1925 was 442,930 pounds, valued at $399,326, compared with 179,103 pounds valued at $182,515 for the first nine months of 1924, prior to the reduction in the tariff rate. An increase in the activities of the textile trade during 1925 and the latter part of 1924 was a factor in the increased imports after the tariff reduction. There has been, however, an increased competition from foreign dyes, principally of the higher cost types used for special purposes. These dyes have been almost entirely of German and Swiss manufacture.

The following table shows the imports of dyes into the United States from 1920 through March, 1926:

Period	Pounds	Invoice Value
1926 (total three months)	1,157,290	$1,097,164
1925	5,315,158	4,791,908
1924 (first nine months)	1,611,931	1,642,632
1924 (last three months)	1,410,608	1,266,146
1924 (total)	3,022,539	2,908,778
1923	3,098,193	3,151,363
1922	3,982,631	5,243,257
1921	4,252,911	5,156,779
1920	3,402,582	5,763,437

Relation of Production to Consumption

The imports of coal tar dyes in 1925 were 6.2 per cent of the total production by quantity and 12 per cent by value. They were by quantity over 8 per cent of the apparent consumption, assuming this to be equivalent to production plus imports, minus exports. The dyes manufactured in the United States based on preliminary figures, accordingly supplied about 92 per cent of apparent consumption by quantity of coal tar dyes. By value, however, domestic production would be considerably less than 92 per cent of consumption, as the average of the domestic production. There was an exportable surplus of certain dyes.

The total exports of coal tar dyes in 1925 was 25,799,889 pounds, valued at $6,694,360. This represents an increase of 64 per cent by quantity and 19 per cent by value over that of 1924. Our export trade has recorded a steady improvement since 1922 and consists largely of Indigo and Sulphur Black. The peak year was in 1920 when the exports were valued at nearly $30,000,000, prior to the reappearance of German dyes upon the world markets.

Domestic Exports of Dyes

	Pounds	Value
1920	.....	$29,823,591
1921	.....	6,270,139
1922	8,344,187	3,996,443
1923	17,924,200	5,565,267
1924	15,713,428	5,636,244
1925	25,799,889	6,694,360

The Dyer's School of Experience

[Editor's Note.—*The following narrative is one of a series being published under the general head of "The Dyer's School of Experience." Realizing that the genuine material for such a series is to be found largely among its own readers, The* Reporter *solicits contributions from that source and will pay for those accepted at regular space rates. Among the readers of this journal there should be many who have, in the course of their experience as dyers or chemists, encountered incidents which should prove most interesting and helpful to their fellows. Send all manuscripts to* American Dyestuff Reporter, *90 William Street, New York City.*]

RESEARCHING UNDER DIFFICULTIES

By Noel D. White
Davenport Hosiery Mills, Chattanooga, Tenn.

WHEN in the beginning of my career as a dyer a school of chemistry was opened in the dyehouse in which I was serving my three years' apprenticeship, I joined the class. Two times a week, a two-hour session was spent in the classroom studying the rudiments of chemistry applied to dyeing. The school was kept open for a period of six months and then discontinued for lack of students, much to my chagrin. Since then I never found the opportunity, or rather the will, to study at my expense until later, as I related in my last paper.

I found then an object to study for and started in earnest. I bought a correspondence course in one of the leading schools, and for a number of years applied myself to the task in my spare time. When I came to the point where I could experiment with chemicals, I got curious to see some of the reactions which I was studying about. Placing some zinc in a flask, I took a rubber stopper with two holes, inserted a glass funnel tube in one hole and a glass tube bent at right angles, and with one end drawn into a fine point into the other hole, stoppered the flask with it. Then I poured dilute sulphuric acid into it through the funnel, filling one-half the flask, and watched.

I had learned that the bubbles produced in the reaction

would be hydrogen gas which on passing out through the jet pointed tube, if lighted with a match, would burn with a quiet, blue flame. I had been cautioned to let all of the air contained in the half-filled flask pass out before lighting. I watched the bubbles come up for what I thought a sufficient period, then struck a match and applied it to the end of my gas tube and—BANG!—when I had gathered my wits I found that my apparatus had disappeared, also my curiosity about hydrogen gas. The only thing I found was the rubber stopper.

About two years after starting my study of chemistry, I was offered a better position. I had by this time a laboratory in my house and was hoping that in my new position I would find room to set it up some place in the shop, but when I got there I found no room for it. After a while, as I proceeded with my study, there was need of more pieces and I had to go to the nearest city for them. I had now arrived at the point where I could analyze the water for the dyehouse for traces of iron. The water from the river was contaminated with vegetation and also from the refuse of a foundry and machine factory about half a mile up the river. I was able to convince the management that in order to do the work properly they needed a system of filtration, and we installed a Hungerford & Terry set of filters.

The Unnecessary Chemist

This firm was one of the biggest silk manufacturers of the country, with mills in several States. When I told them that I was studying to be a chemist, they told me that it was a nice thing and said that every dyer should be a chemist anyhow. When I showed them the expense I was undergoing, buying pieces of apparatus and chemical reagents, I firmly believed they would think that if I were making a better man of myself I would be worth more money to them and would be willing at least to help. But I had to find out that I was mistaken. They thought they had no use for either a chemist or a laboratory.

There was gas piping in the mill just outside my office. I went to the manager to ask him to extend the gas line into my room for some experiments I wanted to make. He said he would but I never got it. Later, I asked again, and again was told that I would get it; but I finally was informed that the insurance company would object to having gas in my room.

We were using here up to four barrels of soap a day and were having trouble disposing of the refuse which could not be let into the river but was piped to the sewer to be carried out to sea. I thought of recuperating the fat for them by running it into a cistern, breaking the soapsuds with sulphuric acid, skimming the fat and pressing it in bags to be put into barrels to sell to soap manufacturers again, as I had seen it done elsewhere. They thought the expense too great to start with, so they kept on running it into the sea and repairing the sewer ever so often. This was at a time when labor was about two dollars a day and the expense of installing the recuperating system would have been about five hundred dollars.

Once I was in need of some reagents for some experiment, and as we were buying a lot of chemicals for the dyehouse I thought of asking the manager to send to the wholesale chemical house where we were buying our chemicals and let them procure the reagents for me. I felt sure that they would oblige us and get them. All I wanted was one ounce each of about ten cheap chemicals that we did not use regularly. I told him that I wanted them for my experiments. He said he would get them for me. But he got them in a wholesale drug store and with them came a bill for $5.15 and a note from the office that it would be taken out of my next pay. That time my wife had to economize on the price of her Easter bonnet.

Dyeing Silk Heavy Black

On one of my excursions to Paterson, N. J., where I have many friends among the dyeing trade, I was visiting an old dyer and talking shop as usual. He told me of a new process for dyeing heavy black, used in his shop, one of the largest in the country. He gave me all the particulars and I decided when I went home that I would try it on a small scale to see if it worked. It may be a process well known now and generally used in silk dyeing, but perhaps some of the readers would be glad to know it, so I give here the exact formula, for it is a good process and I hope it will be of help to someone.

The well boiled-off silk is washed preparatory to giving it three passes in bichloride of tin and phosphate in the usual manner:

Bichloride of tin at 30 deg. Be., ice cold.
Phosphate of soda at 5 deg. Be. (140 deg. Fahr). No silicate used.

After the third pass in phosphate and washed, a bath is prepared with:

60 per cent soap.
200 per cent Logwood No. 3590.
20 per cent Hematine No. 100.
1 per cent Methylene Blue.
1 per cent Chrysoidine.

Logwood and hematine are numbered and sold by Stamford Manufacturing Company.

Shade of black is corrected to shade with more or less Methylene Blue or Chrysoidine.

After dyeing, silk is washed with a little ammonia in lukewarm water, rinsed, and then finished in a wash containing:

15 per cent acetic acid of 28 per cent strength.
3 per cent glue, 2 per cent olive oil and 1 per cent carbonate of soda boiled together.

My result was a 30-ounce silk of beautiful black.

When I returned from my trip I wrote to Stamford

(*Concluded on page* 309)

Proceedings of the American Association of Textile Chemists and Colorists

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MARCH MEETING OF RHODE ISLAND SECTION

The March meeting of the Rhode Island Section of the American Association of Textile Chemists and Colorists was held in the Jesse Metcalf Laboratory of Brown University on Friday evening, March 19.

Ralph F. Culver presided, owing to the absence of Chairman Williams.

The speaker of the evening, Professor E. K. Strachan, Laboratory of Physical Chemistry, Brown University, was introduced and gave a most interesting lecture on "The Accurate Measurement of Acidity As an Aid to the Textile Chemist." The discussion was illustrated by exhibition of apparatus and demonstration of methods.

A resumé of Professor Strachan's lecture and of the discussion that followed appears below.

A rising vote of thanks was extended to Professor Strachan.

The meeting adjourned at 10.15. Over sixty members and guests were present.

Respectfully submitted,
A. N. DANA, *Secretary.*

The Accurate Measurement of Hydrogen Ion Concentration As an Aid to the Textile Chemist

By E. K. STRACHAN

Assistant Professor of Chemistry, Brown University

It is my purpose to explain the meaning of the term pH, to tell how it is measured, and to suggest how this accurate method of defining and measuring acidity and alkalinity may be advantageously employed in textile finishing processes.

DEFINITION OF pH

pH is a unit on the acidity-alkalinity scale just as °F is a unit on the temperature scale or °Be is a unit on the density scale. Just as truly as one may measure temperature or density without being able to define either the degree Fahrenheit or degree Baumé, so also he may measure pH and profit by his measurements whether he can define the unit or not. Thus extensive knowledge is not necessary for the use of this unit of measurement. On the other hand, a full understanding of the subject is both interesting and advantageous.

Before coming directly to the term pH, I wish to explain the terms *total acidity, active acidity* and *reserve acidity,* for these ideas are intimately bound together. The distinction may be illustrated best by the concrete examples which follow.

A liter of acetic acid contains about the same number of molecules as a liter of nitric acid (pure acetic acid is 1.5 molar, 45 deg. nitric acid is 17.7 molar). The same number of pounds of caustic soda or soda ash would be required to neutralize a quart of either acid. If we should pour a liter of either of these acids into 170 liters of water we should have in either case an approximately tenth normal solution. A 25 c.c. sample of either would consume the same quantity of N/10 soda solution. The two acids have the same total acidity; both can neutralize the same quantity of alkali. But we know acetic is a

weak acid and nitric is a strong acid. Wherein does this difference lie?

The difference lies in the active acidity as contrasted with the total acidity. Let us turn to the electrolytic dissociation theory for an explanation. Every acid when dissolved in water is broken up to a certain extent into its ions, the ions being atoms or groups of atoms bearing electric charges. If acetic acid is poured into water a certain number of its molecules separate into ions thus:

$$H\,C_2H_3O_2 = H^+ + C_2H_3O_2^-$$

and similarly a certain number of the molecules of nitric acid ionize thus: $HNO_3 = H^+ + NO_3^-$. Both nitric and acetic acids form hydrogen ions when they dissociate, as do, in fact, all other acids. Indeed, we may define an acid as a substance which yields hydrogen ions when dissolved in water. The difference between the two acids lies in the difference in the number of molecules of each that will ionize. In tenth normal solution about 90 per cent of the nitric acid molecules will break up into ions, while in the acetic acid solution only a little over 1 per cent of the molecules will ionize. Thus, it is easy to see that the tenth normal nitric acid contains 0.09 gram of hydrogen ions in a liter while the acetic acid has only 0.001 gram of hydrogen ions in a liter. It is this difference in the hydrogen ion concentration that makes one a strong acid and the other a weak one. This statement may be expanded to include all acids, for all acid solutions contain hydrogen ions. Various acids differ, however, in the extent to which they are dissociated. Those which are highly dissociated furnish many hydrogen ions and are consequently strong acids, while those which are slightly dissociated furnish few hydrogen ions and are weak acids. We shall see presently that pH is a convenient unit for expressing hydrogen ion concentration.

Now the strength of the acid, or the intensity of its acid qualities depends on the concentration or strength of hydrogen ions. The hydrogen ion concentration, then, may be described for want of a better term as the active acidity. The difference between the total acidity and active acidity is the reserve acidity. It consists of the molecules of acid which have not dissociated into ions. The undissociated molecules can dissociate whenever any of the hydrogen ions are used up. In this way they act as a reservoir of hydrogen ions or reserve acidity.

The relation between active acidity and total acidity is somewhat similar to the relation between heat and temperature. Temperature measures the intensity of the heat energy while B.t.u. represents the quantity of heat energy. Similarly active acidity represents the intensity of the acid action while total acidity measures the quantity of acid. The ocean contains vast quantities of heat, but we could not warm our houses with it for its temperature is too low. Carbolic acid is not a suitable acid for dissolving metals because its active acidity or hydrogen ion concentration is too small. Many other chemical processes are governed by the active acidity rather than the total acidity. Just as chemical processes depend very greatly on the temperature of intensity of the heat so do many of them depend on the hydrogen ion concentration or intensity of the acidity rather than on the total pounds of acid present.

Total acidity may be measured in terms of the percentage strength of an acid, or normality, or the pounds of soda to neutralize a quart of it. A different scale must be used to measure active acidity. Such a scale must express all ranges of active acidity or hydrogen ion concentration from that of pure water up to that of the strongest acid. This may be done in a variety of ways, some of which are exhibited in the accompanying table. Column 1 lists various solutions of acid and column 2 the hydrogen ion concentration of each as determined by

TABLE

To Show Relation of pH to C_{H^+} and C_{OH^-}

1. Solution	2. C_{H^+}	3. C_{H^+}	4. pH	5. C_{OH^-}	6. C_{OH^-}	7. Solution
0.11 N HNO_3	0.1	10^{-1}	1			
0.01 N HNO_3	0.01	10^{-2}	2			
0.055 N Acetic Acid	0.001	10^{-3}	3			
0.0005 N " "	0.0001	10^{-4}	4			
1N Carbolic Acid	0.00001	10^{-5}	5			
0.01N " "	0.000001	10^{-6}	6			
Water	0.0000001	10^{-7}	7	10^{-7}	0.0000001	Water
		10^{-8}	8	10^{-6}	0.000001	
		10^{-9}	9	10^{-5}	0.00001	0.03N Aniline
		10^{-10}	10	10^{-4}	0.0001	
		10^{-11}	11	10^{-3}	0.001	0.035N NH_4OH
		10^{-12}	12	10^{-2}	0.01	
		10^{-13}	13	10^{-1}	0.1	0.12N NaOH

measurement of the electrical conductivity, potential of the hydrogen electrode or by other suitable means. Even water contains a certain number of hydrogen ions, for it is slightly dissociated according to the equation:

$$H_2O = H^+ + OH^-.$$

A liter of pure water, however, contains only a very small number of grams of hydrogen ions in a liter, and the decimal fraction to express it is a long one. The weaker the acid, the more the decimal places required to express its hydrogen ion concentration. Because of the size of these figures which appear in column 2, a more convenient form of expression has been found which is shown in column 3 of the table. In this column we see an index, a number written to the right of and above the 10 to indicate how many times one has been divided by ten to

get the small number shown in column 2. This is a more convenient and compact method of expression. But even this simplification is not sufficiently brief for those who use these numbers a great deal. So we see in column 4 the pH or simplest method of expressing these quantities. The pH is merely the exponent of the 10 with its sign changed to plus instead of minus. Thus, pH4 means 10^{-4} or 0.0001 gram of hydrogen ions in a liter. Defined mathematically $pH = -\log C_{H^+}$. This definition enables us to employ fractional values of pH. For example, 0.1 N nitric acid has $C_{H^+} = 0.09$. Now, $\log 0.09 = \overline{2}.95 = -1.05$. Consequently, since $-\log 0.09 = 1.05$ the pH of this solution is 1.05. It is possible to express every degree of acidity from pure water up to that of a strong acid in this manner by a number on the pH scale. The acidities so expressed represent the active acidity, or hydrogen ion concentration as contrasted with the total acidity or neutralizing power of the acid.

But this is not the only advantage of this system of units, for it can be used also to express alkalinity, or the absence of acidity, if you care to think of it in such a way, on the same scale.

Just as the presence of H^+ is the characteristic factor of an acid solution, so OH^- is the distinguishing feature of an alkaline solution. All bases when dissolved in water dissociate to form OH^- ions. The strength of a base depends on the concentration of the hydroxyl, OH, ions in the same way that the strength of an acid depends on the concentration of hydrogen ions. Columns 5 and 6 of the table show the OH^- concentration of the solutions of the bases listed in column 7. Ammonia, a weak base, of course, has a much lower hydroxyl ion concentration than caustic soda, a strong base.

The relation betwen acidity and alkalinity involves a consideration of the ionization of water and the nature of neutralization. Considering first neutralization, the action of sodium hydroxide and hydrochloric acid may be represented by the equation:

$$NaOH + HCl = NaCl + H_2O$$

Or, if we remember that caustic soda, hydrochloric acid and sodium chloride are all highly dissociated we may write:

$$Na^+ + OH + {}^-H + Cl^- = Na^+ + Cl^- + H_2O$$

and eliminating those things which occur on both sides of the equations there remains:

$$OH^- + H^+ = H_2O$$

No matter what acid and base are used the essential thing about neutralization is the formation of water from H^+ and OH^-.

When neutralization occurs the hydroxyl and hydrogen ions do not all combine to form water; a certain number of them always remain in the undissociated form. This fact was stated previously when I said that water is partly dissociated according to the equation:

$$H_2O = H^+ + OH^-$$

The degree of dissociation of water is very small and in fact amounts to only 0.0000002 per cent of the number of water molecules present, or only one molecule in five million is dissociated. Nevertheless, every aqueous solution contains the ions of water so that even the strongest acids contain OH^- and all alkaline solutions contain H^+. The number of hydrogen ions in an alkaline solution or of hydroxyl ions in an acid solution may be calculated. This involves the mass action law, which tells us that the concentration of hydroxyl ions multiplied by the concentration of hydrogen ions is equal to a constant, i. e.,

$$C_{OH} \times C_{H} = K_{w} = 10^{-14} \text{ (at 25 deg. Cent.)}$$

Another way of expressing this law is to state that the concentration of hydrogen ions varies inversely as the concentration of hydroxyl ions; that is, the more hydroxyl ions the fewer the hydrogen ions. This ionization constant, or more properly ion product, of water enables us to compute the concentration of hydrogen ions in an alkaline solution. By dividing 10^{-14} by the concentrations of hydroxyl ions we obtain the hydrogen ion concentrations of an alkaline solution. Column 3 of the table shows the hydrogen ion concentrations corresponding to the hydroxyl ion concentrations of the alkaline solutions in column 5. The values of pH corresponding to these hydrogen ion ion concentrations are shown in column 4. Thus, this well-known relation between the hydrogen ion and hydroxyl ion concentration of an aqueous solution, enables us to express any degree of acidity or alkalinity on a single scale. It is interesting to note that pH7 refers to a solution in which the hydrogen ion and hydroxyl ion concentrations are equal. Such a solution, of course, is neither acid nor alkaline but is neutral. This is also, of course, the pH of pure water. If the pH of any solution is less than 7 it is acid, but if greater than 7 it is alkaline. The concentration of hydrogen ions then determines whether the solution is acid, basic or neutral and to what extent it is so. This methods of expression is of considerable convenience at times, particularly when one is dealing with solutions that are nearly neutral.

The Measurement of pH

There are two general methods of measuring the hydrogen ion concentration, or active acidity, of a solution with several variations of each method. These are the electrical and the colorimetric methods.

The electrical method consists in measuring the elec-

tromotive force of a hydrogen electrode which is dipped in the solution under investigation. The usual hydrogen electrode consists of a piece of platinum foil or wire covered with platinum black and contained in a suitable vessel. A device is provided for bubbling hydrogen over the platinized electrode. The other electrode necessary for the formation of the electric battery consists of a calomel electrode. The solution under examination is placed in the hydrogen electrode vessel, suitable junction is made with the calomel electrode, and the difference of potential of the two electrodes is measured by a potentiometer. The hydrogen ion concentration is a function of the electromotive force, the pH being directly proportional to the measured potential. If a saturated calomel electrode is used, the relation between pH and potential is expressed by the formula:

$$E = 0.249 + 0.05906 \text{ pH at } 25 \text{ deg. Cent.}$$

The electric method of measuring pH is quick and exact and is independent of the color of the solution. It has its limitations, however. The apparatus is expensive, is not easy to adjust and is very apt to get out of order. It requires skilled care and operation to get reliable results with it. Many substances poison the platinum electrode. It is useless in solutions of oxidizing and reducing substances. The quinhydrone electrode overcomes some of these difficulties, but it has disadvantages of its own. A number of other electrodes have been used, but in my opinion they are still in the experimental stage.

As an alternative to the electric method we have the colorimetric method. This can be used in a number of situations where the hydrogen electrode cannot. The most precise colorimetric measurements involve the use of buffer solutions of known hydrogen ion concentration. A series of such buffer solutions is made which differ from each other by 0.2 pH, for example, and a set of color standards is prepared from them by adding a standard quantity of indicator solution to each. When it is desired to ascertain the pH of a solution, the standard quantity of indicator is added to it and the color matched with the color standards. I have here on exhibition a set of such color standards. Since an indicator changes its color completely within a narrow range of one or two units of pH, a number of different indicators must be used to complete the entire scale. A comparator is useful for matching the colors. If the specimen is a colorless liquid the pH can be readily determined within 0.2 units. When a colored solution is to be examined, two specimens of it are placed in test tubes without addition of indicator. These specimens are placed in the comparator behind the standard buffers so that in making a comparison one must look through the colored buffer solution and the specimen at the same time. The eye then perceives that color which the solution would exhibit if it had the pH of the buffer and contained the standard quantity of indicator. A third specimen of the unknown solution is treated with the standard amount of indicator and placed between the two blanks. By shifting the color standards about it is fairly easy to obtain a good match. The specimens exhibited here are samples of a nickel plating bath. They are quite dark green in color, but, as can be seen, the pH lies betwen 5.8 and 6.0. This is a satisfactory acidity for a nickel plating bath. Recent experiments indicate that with such dark colored solutions the pH determination may be in error by 0.2 or 0.3 pH. Such a small error, however, does not invalidate the method for the control of plating solutions nor for many other technical purposes since the working range is fairly wide, being in this case from about 5.5 to 6.5. Outside these limits the nickel deposits are unsatisfactory. The method has been of considerable value in the plating industry. This example serves to demonstrate that a colorimetric determination pH may be made in a highly colored solution with fair accuracy.

There are several other ways of making these colorimetric determinations. I refer anyone who is particularly interested to the book, "The Determination of Hydrogen Ions," by Mansfield Clark. I will refer to only one other method. With colorless solutions it is possible to make a fairly accurate determination by merely putting the standard quantity of indicator into the solution in a test tube and comparing the color with the colors on a color chart of the form I am showing you now. These color charts may be obtained from the Williams & Wilkins Co., of Baltimore. Recently a universal indicator has come on the market which can be used for all pH's from 4 to 11. It is not valuable for measurements of fractional pH's.

Application of pH Measurement to Textile Finishing

There is very little that I can say about the successes which have been achieved already by the application of pH measurements to textile finishing processes, for so few studies have been made of this subject. Therefore, I shall have to confine myself principally to the suggesting of applications of such pH measurements as I believe are apt to yield useful results.

However, before making any suggestion for future experimentation I want to refer to some very interesting and suggestive work that has been done in connection with the theory of dyeing. This work has been done principally by Speakman[1] in England and by Scott[2], your

[1] Journal of the Society of Dyers and Colorists, Vol. XLI, p. 172 (May, 1925).

[2] American Dyestuff Reporter, Vol. XIV, p. 862 (Dec. 28, 1921).

own society. The work, of course, is as yet in the experimental and theoretical stage, but it marks progress in the effort to ascertain the laws on which the dyeing process depends. Speakman has shown that wool, an amphoteric electrolyte, shows a well defined iso-electric point, or point of minimum neutralization by acid or base, at pH 4.8. At acidities lower (pH higher) than this wool does not unite with acids. He further concluded that the per cent neutralization of the wool by the acid depended only on the pH and not on the total pounds of acid in the solution. Speakman employed only mineral acids. It is likely that his conclusions are valid for acid dyes also. If such is the case, the quantity of dye absorbed from a solution should depend directly on the pH and not on the quantity of acid used.

Scott, following out this argument, experimented with silk which is also an amphoteric substance. He found that if the quantity of dye in the bath is the same, the per cent of it which combines with the silk increases as the pH increases regardless of the total amount of acid required to bring about the change of pH. Scott also showed what is even more important, that the amount of the acid color absorbed by the silk is the same if the pH is the same no matter whether the bath is acidified with acetic, sulphuric or hydrochloric acid.

These two researches are suggestive of what may be accomplished toward gaining insight into the mechanism of the dyeing process by measurements of the pH of the dye bath. They are investigations of the part played by the nature of the fiber rather than studies of the character of the dyestuff which has hitherto been the chief point of attack. Of course, both of these factors are included in the dyeing process.

Such studies are of interest and are very important, but have not yet yielded results that are of general technical value. On the other hand, there are processes and materials involved in the finishing of textiles to which pH measurements can be applied at once with certainty of success. The most prominent of these is the purification of water. When water is purified by use of alum the success of the purification depends upon getting a good flocculation of the aluminum hydroxide precipitate. A good flocculation can be obtained somewhere between the limits pH 6 to pH 8. The optimum value of the pH depends on what impurities, mineral salts, etc., which are present, and must be determined for each particular water supply by experiment. Once the optimum value is established, however, pH measurement affords an excellent method of controlling the water purification. The scouring of wool and degumming of silk are also processes dependent on the pH. Too little alkalinity makes the process unsuccessful, while too much alkali damages the fiber. Bacteria and moulds thrive only within certain limits of acidity and alkalinity. A change in pH of only one or two units will cause the death of many varieties of them.

The measurement of pH is a more accurate test for elimination of bleach than the starch iodide test is, for when washing out bleach, long after the starch iodide test shows no chlorine, the pH measurement will show that the material is still acid. These small quantities of acid may be detrimental to the strength of the fiber if not removed.

Corrosion of metal parts of machinery and pipes is many times due to slight acidity or alkalinity. This can often be detected and controlled by measurement of pH.

Discussion

Mr. Dana—Has the iso-electric point been determined for cotton?

Dr. Strachan—Not that I know of. Both wool and silk show iso-electric points. It is to be expected from their albuminous nature that they should be amphoteric and possess iso-electric points. We are repeating the work of Scott and Speakman on these substances, after which we expect to examine cotton, rayon and possibly other fibers which because of their colloidal nature might show iso-electric points although they are not chemically amphoteric.

Mr. Dana—Supposing such a point were determined, would you be able to decide on which side of this point the cotton would show an affinity for dyestuffs? Would this point determine whether a certain dyestuff would require caustic soda or acid in the dye bath?

Dr. Strachan—As far as I know you would expect it to take up acid on one side and alkali on the other side. However, does cotton show any affinity for acid dyes?

Mr. Dana—There are certain colors that dye better with acid, such as Benzo Brilliant Skyblue 8G, as well as all basic colors.

Dr. Strachan—It might also be interesting to study the iso-electric point, if there is one, for mordanted cottons. This would apply to basic colors.

Question—I would like to have you explain in a little more detail what a "buffer" is. Does the range limit of the pH differ according to how much acid there is?

Dr. Strachan—Yes, within certain limits. A buffer solution, I would say, is a solution of definite hydrogen ion concentration which is capable of taking up a small amount of acid or alkali without seriously changing its hydrogen ion concentration. For our purposes we only need the first part of that definition. A buffer solution is made up of a weak acid and one of its salts. One of the simplest examples I could give you would be acetic acid mixed with sodium acetate. That would have a definite hydrogen ion concentration depending on the proportions of the two, and it could take up a little acid or a little alkali without changing the hydrogen ion concentration

a great deal. For indicator work we can use mixtures of dipotassium hydrogen phosphate, potassium acid phthalate, or boric acid and borax.

Question—In a vessel holding about 1,000 gallons of water, approximately how much sulphuric acid would be required to change the pH from 7 to 6.6?

Dr. Strachan—If the vessel contains pure water, its pH is 7. If you add to it about 0.1 c.c. of sulphuric acid the pH will change to about 6.6.

Mr. Taylor—Will you compute a "buffer"?

Dr. Strachan—To obtain a buffer of pH 7 the following calculations are involved:

$$NaH_2PO_4 \rightleftharpoons Na^+ + H_2PO_4^-$$

$$H_2PO_4^- \rightleftharpoons H^+ + HPO_4^=$$

$$\frac{C_H \quad C_{HPO_4^=}}{C_{H2\ PO_4^-}} = K\ 2 \times 10^{-7}$$

$$Na_2HPO_4 \rightleftharpoons 2Na^+ + HPO_4^=$$

$$C_{H^+} = K\frac{C_{H_2PO_4^-}}{C_{HPO_4^=}} \quad 2 \times 10^{-7}\ \frac{cc\ C_{NaH_2PO_4}}{cc\ C_{Na_2HPO_4}}$$

$$\text{If } \frac{C_{NaH_2PO_4}}{C_{Na_2HPO_4}} = 1/2 \qquad C_{H^+} = 10^{-7}$$

Mr. Deady—Why is it that the amount of dissociation is the same in the two salts?

Dr. Strachan—Most of our sodium salts of similar acids are dissociated to about the same extent. That just happens to be the fact. It is not precisely true, but approximately the degrees of dissociation are about the same. Now, the only thing that we can do for precise work is to compute the proportions as closely as we can and then standardize by the hydrogen electrode. By that method we can get the exact figure.

Mr. Dick—If the solution is stronger than normal, have you any way of determining the pH?

Dr. Strachan—Yes, the hydrogen electrode would give it to you as well as any way.

Mr. Dick made an inquiry regarding the corrosion of metals by strong nitric and sulphuric acids, and if the extent of corrosion depended only on the pH. The discussion became general, Dr. Strachan pointing out that the hydrogen ion concentration was not the only factor influencing corrosion and that with strong acids it is often a minor factor.

Mr. Wingate—Would it be necessary to test each solution in each dye bath when it is made up fresh?

Dr. Scott—When the formula is once established, that is, when you have found the correct amount of dye to use, correct amount of water and correct percentage of acid, you can assume that the pH is about the same.

Mr. Wingate—Is the method practical for the testing of vat dyes?

Dr. Scott—It is not applicable to test in vats as yet and there has not been much work done on the subject. The color of the vats makes it difficult to recognize the change in the indicator and the reducing properties of the hydrosulphite of soda strongly interferes with the result.

Mr. Deady—Have you done anything on viscose and rayon?

Dr. Scott—Of course, rayon would be quite closely comparable to cotton and would be more or less inert. Various manufactures of viscose act differently.

Mr. Flynn—In regard to wool dyeing: I understand that you can control the dyeing by the condition of the wool and the water. Now, you take a certain lot of wool and a certain acid color, for instance, and it will dye in a neutral bath. For another acid color you might have to put in considerable acid in order to force the dye on to the wool. Therefore, do you not have to study each dyestuff pretty much by itself?

Dr. Strachan—I would suggest this before I would come to that conclusion: Some dyes in their manufacture are diluted with salt and soda. (Laughter.) I would say that the dye that was mixed with soda would be alkaline to start with and would require acid. For acid colors you would have to put in acid to make them take on the wool. You would have to go into the study of each particular dyestuff to control wool dyeing. Before you could answer that you would have to study a whole lot of them and if you found them all alike, it would be fine, and if you found them all different, that would be fine, too, for then you would have a great deal to study. (Laughter.) Dyeing undoubtedly depends both on the dye and fiber.

Mr. Claflin—There is one point that I would like to suggest about the scouring of wool, and that is the question of color indicators for the alkaline range of pH's—that is, from 9 to 11. That seems to be particularly important as regards to scouring wool. You have to get a pH there that is high enough so that the dirt will not adhere to the wool and yet if you get it a little too high the wool is damaged.

Dr. Strachan—I think Thymol Blue is about in that range.

Mr. Claflin stated that he had tried it and found it unsatisfactory. None of the well-known indicators seemed to be suitable.

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AMERICAN
DYESTUFF REPORTER

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto.

LOUIS A. OLNEY
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TEXTILE CHEMICAL SPECIALTIES—THEIR MERITS AND DEMERITS

DURING the past year there has appeared in certain trade publications a great amount of editorial discussion, both pro and con, regarding the merits and demerits of various proprietary compounds sold to textile mills for certain specific uses. The products generally under discussion have been prepared oils, emulsions, sizings, softeners and the like.

The attacks made upon these products have, in a general way, claimed the following faults:

1. That chemical analyses of the product reveal them to be composed of ingredients whose collective market value is far below the price charged for the completed mixtures;

2. That many of the ingredients included in the mixtures serve no beneficial purpose and are, therefore, to be classed as mere adulterants and that some of the ingredients are actually harmful;

3. That there is a very high water content in many of the mixtures;

4. That these products are sold to mills by means of commercial bribery;

5. That mills can much more efficiently and economically manufacture their own products of this character than by purchasing them from specialty houses.

In defense of these charges it has been alleged:

1. That although the component materials for any mixture may readily be purchased at considerably less than the price asked for the completed product, there enters, nevertheless, into the making of the mixture specialized scientific and empirical knowledge which renders the product superior for the specialized purposes for which it is intended;

2. That it is necessary in most cases to include in any mixture inert material which shall act as a proper vehicle for carrying valuable reagents; that no harmful ingredients are included by reputable manufacturers;

3. That water is an essential part of most of these products and that it cannot be satisfactorily added at the mill if the product is purchased in a dry state;

4. That while commercial bribery undoubtedly exists to some extent in the sale of these products it does not exist in all or even a substantial percentage of cases and that it is, therefore, unfair to place all manufacturers selling products of this type in one class;

5. That while very large mills whose organizations include competent chemists and practical men of wide experience can no doubt manufacture products of this type in their own plants as well or nearly as well and certainly more economically than they can buy them from other sources, this is, however, true only in the cases of large mills; and that the multitude of smaller mills who are not so fortunately situated cannot hope to produce products comparable with those manufactured by specialists.

These charges and countercharges have naturally come to the attention of The REPORTER but, up to the present time, we have preferred to remain in the role of a disinterested spectator. Of late, however, it has been forcefully brought to our attention that many innocent parties are being harmed. This is true of both the manufacturers of specialized products and of the mills themselves.

While it is undoubtedly true that many small manufacturers of textile oils, sizings, finishing compounds and the like do put upon the market products which are of very inferior quality and extremely doubtful worth and that they do depend almost exclusively upon commercial bribery as a means of selling these products to the mills, it is also equally true that by far the greater number of such products are manufactured and merchandized by concerns which employ the highest type of chemical and practical manufacturing talent to devise and supervise the manufacture of their products and that they are merchandized on an absolutely honest basis. It is, of course, true that any of these products must cost materially more than the raw materials from which they are made. No concern is in business without the expectation of making a profit on the sale of its wares. Skilled technical ability of the highest class forms the greatest single item in the cost of the manufacture of products of this type and in turn produces products which are of the greatest value to the purchaser. No mill of moderate size can possibly hope to manufacture for itself products of this type which will be in any way comparable to those obtainable from large and reputable specialty manufacturers.

The reputation of the AMERICAN DYESTUFF REPORTER as a technical publication is so thoroughly established and our ethical standards are of such a class and so generally understood that we feel we can speak on this matter with entire fredom from any aspersions on our motives. Only after consulting a number of leading technical mill men of the country and ascertaining their sentiments in the matter have we ventured to place ourselves on record.

We hold no brief for manufacturers of adultered or inferior products nor do we countenance commercial bribery. Our repeated editorials on the "graft" question

and our sincere desire to co-operate with any movement which can successfully curb the practice furnish ample testimony to this effect. We feel, however, that by tarring with the same brush all manufacturers of specialized textile compounds a grave injustic is being done not only to reputable concerns in this field, but also to the mills which have heretofore depended upon them for supplies and whose confidence in these concerns may be shaken to such an extent that they will endeavor to substitute articles of their own manufacture which, though possibly cheaper, cannot conceivably yield satisfactory results.

We believe that mill superintendents, dyers, finishers and others who may be called upon to make decisions regarding the purchase of materials of the type in question can readily be relied upon to use their judgment as to the character of the materials which they buy, as to the results accomplished by their use and as to the reliability and honesty of the concerns from whom they are purchased.

We do not wish to be drawn into any protracted discussion of this subject. We have said here all that we have to say but, out of fairness to those of our subscribers who may have come under suspicion because of their defense of certain proprietary products and to those manufacturers of such products as are unquestionably above reproach, we feel that the statement of our convictions as contained herein is proper.

LOOKING AT THE DARK SIDE

THE advance report of the Tariff Commission covering the American dye industry's progress during 1925 includes much that is very encouraging. Dyestuff production rose 25 per cent above that of the previous year; sales increased 22 per cent in quantity, though only 5 per cent in value; exports of our dyes showed the surprising expansion of 64 per cent over those of 1924 in quantity and 19 per cent in value. There was conspicuous progress in the manufacture of new fast dyes. These are all definite indications that in 1925 the American textile industry resumed activities and that the American dye manufacturer was wide awake in meeting the increased demand for his products both here and abroad.

One or two adverse conditions mentioned in the report, on the other hand, tend to offset this encouraging progress to a greater extent than might be supposed at first glance. Imports of foreign dyes jumped 75 per cent in quantity and 65 per cent in value during 1925. Domestic prices dropped nearly 14 per cent below those of the previous year. Regarded superficially, these two items might be considered merely as balancing factors, and in this light the report would appear quite normal, if not actually encouraging. But it is always instructive to face facts squarely, no matter how unpleasant they may be. Nothing is gained by glossing over sore spots in an industry with an exuberant but blind optimism. The condition in this case which calls for urgent attention should be clear to anyone who recognizes that increased imports are a sign of increased foreign competition and that reduced prices in the home market clearly indicate increased domestic competition. These two conditions must be recognized in their true significance if the American dyestuff industry expects ever to reach a more profitable level of operation.

In spite of increased production and sales and exports of American dyes last year, in spite of notable technical progress, the figures for 1925 for prices and imports plainly show that foreign and domestic competition is steadily growing acute. The dye industry and the textile industry have a vital problem to face. Phrased in its simplest form that problem is plainly one of making dye manufacturing profitable in the United States. Obviously we cannot long maintain an industry that is not profitable. Like any other, the dyestuff manufacturer is in business primarily for profit and deserves it. Without this profit it is only a question of time before his expensive plant operations must be curtailed or stopped entirely.

But why in the name of industrial efficiency does he believe that he is making his business more profitable by duplicating some competitor's range of colors and entering those products in an overcrowded market at prices below cost of production? Would it not be far more scientific, far more sensible business practice if competitors were to unite in working out allocation of markets and production, with the end in view of strengthening the entire industry by eliminating wasteful duplication? Of course, this is not a new idea. Much has been written upon it before. Mergers and combinations have solved the same problem in scores of industries. There is no reason why such a plan would not cut away much of the competition in the American dyestuff industry to-day.

In any economic struggle among the units of an industry the ultimate victors are naturally the largest, the strongest and best equipped, the duration of the struggle being determined by the ability of the small units to maintain their grip in the market. But with almost certain defeat facing them, is it not sheer folly for those small units to ignore the benefits of a compromise with the ultimate victors; or, if this be impossible, at least a compromise among themselves? It is nothing short of suicidal to postpone such a step until the numerous smaller units which have been so bravely withstanding the blast of competition have all been swept away. What the American dye industry needs now is a leader big enough in spirit, with a view sufficiently broad and impartial, with an eye to the interests of the textile manufacturer, to bring about a correlation of plant operations and thus reduce to the minimum duplication of effort and overlapping of markets. Obviously this end cannot be achieved without arousing violent opposition from the ranks of the trust-breakers. But it must be achieved, and that soon, for beneath the deceptive encouragement of increased production and sales and exports, as emphasized in the Tariff Commission's report, a crisis can phasized in the Tariff Commission's report, the future of the small manufacturer appears uncertain.

ZINSSER AND ULTRO COMPANIES MERGE

Zinsser & Co., manufacturing chemists, Hastings-on-Hudson, have merged with the Ultro Chemical Company, of 1 Hudson Street, New York. The plant of the Ultro company, as well as its New York office, will be moved to Hastings-on-Hudson. The completed consolidation will represent a well-rounded, fine organic chemical manufacturing unit, producing textile mordants, intermediates, photographic chemicals, alizarine and azo dyestuffs, and dry colors.

The officers of the new company, which will function under the name of Zinsser & Co., Inc., are: F. G. Zinsser, president; William Steinschneider, first vice-president; Herman Staber, second vice-president; J. S. Zinsser, secretary and treasurer.

The F. A. Tomalino Silk Dye Works, which have been operating a plant in Germantown, Pa., for many years, have secured ten acres of land in Salisbury, N. C., and will shortly commence erection of a branch plant there. The site and plant will represent an outlay of $125,000.

PHILIP S. CLARKSON

The entire textile-chemical fraternity will be sincerely grieved to learn of the death on Sunday, April 25, of Philip S. Clarkson at his home at Beverly, N. J.

Mr. Clarkson was born April 13, 1869. After graduating from Lehigh University, he entered the employ of the Quaker City Dye Works, of Philadelphia, as chemist. Shortly thereafter he accepted a position with Herman A. Metz in the laboratory of Schultz-Berge & Koechl. Since that time for nearly thirty-seven years he had been associated with Mr. Metz, and during all his later life was chief chemist in charge of the application laboratories of the various concerns which Mr. Metz has headed.

Mr. Clarkson was widely known throughout dyestuff circles. He was generally regarded, by those qualified to judge, as one of the outstanding authorities of the country on textile-chemical, and especially dyestuff-application, subjects. He was a man whose personality made a deep impression upon those with whom he was brought in contact, and his loss will be deeply felt by all of his associates.

Mr. Clarkson resided for practically his entire life at Beverly, N. J., a town south of Burlington and nearly seventy-five miles distant from New York. Until shortly before his death, however, he commuted daily between his home and the office in New York City—a record in commutation mileage which probably no other individual in America can approach.

Mr. Clarkson was buried at Beverly on Wednesday afternoon, April 28. A large delegation of friends and associates from New York and more distant points attended the services.

RECENT LITERATURE

The Bleaching, Dyeing and Chemical Technology of Textile Fibers. By S. R. Trotman and E. R. Trotman. 610 pages. 163 illustrations. J. B. Lippincott Company. $12.50.

This new volume, designed primarily for the student, is nevertheless so up to date and comprehensive as to be an invaluable reference work for the practical dyer and textile chemist. The book is a modernized course in bleaching and dyeing of textile fibers. The work is divided into forty parts, each problem following in sequence with exhaustive explanation, even to the most complicated chemical technology. In the order of their importance the authors take up the chemical principles involved, acids and bases, salts, reversible reactions, hydrolysis, ionization, hydrogen ion concentration, colloidal solutions and absorption.

Chemical and physical tests used in the valuation of textile materials are one of the many distinctive contributions of this work to the knowledge of the present day laboratory. Formulas are given for dyeing and bleaching cotton, artificial silk, wool and hair. Of equal importance is the information on bleaching and scouring of silk, wool and cotton.

Dyeing machinery is described fully, with profuse illustrations and diagrams. There are also outlined the acid, basic and substantive dyestuffs as well as the developed dyes, sulphur, mordant, aniline black and vat dyestuffs.

Liberal space has been allotted to the dyeing of artificial silk. How to overcome perplexities confronting a dye plant when the artificial silk has different affinities for dyestuffs is not the least of the enlightening facts for the manufacturer and industrial chemist. A brief history of dyeing supersedes the technical descriptions.

Zinc Oxide—History, Manufacture and Properties as a Pigment. By Dalton B. Faloon, B. S. 145 pages. 40 illustrations. $1.75. D. Van Nostrand Company.

A small but unusually comprehensive treatise covering briefly but informatively the history of zinc; zinc ores, zinc oxide; French process zinc oxide; American process zinc oxide, Eastern and Western practice; physical qualities and chemical specifications for all grades of zinc oxide; physical testing methods; and Government specifications and testing methods. The book represents the only work of its kind, dealing as it does exclusively with zinc oxide without digressions into unrelated phases of the subject of zinc in general, the fault of most of the

works available. It has been designed and arranged primarily to help the man who uses zinc oxide.

The Industrial Application of Coal Tar Products. By H. M. Bunbury and A. Davidson. 7 x 9½. Cloth. 284 pages. $10.00. D. Van Nostrand Company.

In this volume the authors have attempted to bridge the gap between works on the production of coal tar and the separation of its constituents and those dealing with textile dyeing, photography, the blending of perfumes, etc. The present treatise endeavors to show how the final products are arrived at from the raw materials. Essentially the aim has been to answer the query, "How is such and such a product obtained and what are its uses?" The authors have merely outlined the methods of manufacture and have confined themselves to those products of technical importance whose commercial application has been established, but in some instances products whose future possibilities seemed to warrant inclusion are given space. No attempt has been made to give all the trade names by which many of the materials are known on the market. As dyestuffs appear to be the most important as well as the most numerous of all products derived from coal tar, a relatively large amount of space has been devoted to them.

The Introductory treats of coal tar as a raw material outlines the dependent industries, covers briefly coal tar fuels, road tars and solvents, dyestuffs, drugs and antiseptics, perfumes, explosives, synthetic resins and tannins, rubber accelerators and other industrial products. The succeeding chapters take up in turn benzene and its derivatives, aniline and its derivatives, toluene, the xylenes, naphthalene, beta-naphthol, phthalic anhydride, anthracene, pyridine, acenaphthene and phenanthrene, phenol, salicylic acid, the cresols and the crudes, with an appendix on the nomenclature of dyestuffs.

Eriochrome Colors. J. R. Geigy S. A., Basle.

An extremely useful swatch book of thirty-two pages, dealing with the Eriochrome Colors, which belong to that group of mordant colors yielding dyeings on wool which possess the best general fastness properties. The text gives dyeing directions in English, French and German. Three shades are shown of each color in the series, with the percentage given in each case.

Naphthol AS. General Dyestuff Corporation.

A volume showing the complete range of Naphthol AS colors, 240 shades in all, exhibited on swatches with dyeing formulas. The first four pages were produced on bleached, mercerized yarn, the others on ordinary cotton yarn. The text explains that after preparing the yarn and developing all the shades in the open vat they were, with the exception of the delicate shades on mercerized, soaped in a continuous dipping and wringing machine. The proportions given for the various shades refer to this method of dyeing.

Factory Practice in Manufacture of Azo Dyes. By W. B. O'Brien, Ph. B. D. Van Nostrand Company. Illustrated. $5.00.

The purpose of this volume is to afford basis for a viewpoint on azo dye manufacturing, in so far as actual factory procedure is concerned, for the general chemist and for those who look forward to the dye industry as a possible field for their professional activity. Informative discussion upon the manipulation and working conditions in the dye factory is not easily available to the student.

For presenting the elements essential to standardized production of azo dyes, the simplest members of that class are to be herein discussed, covering chiefly the mono azo group, by outlining in detail specific methods for preparation of individual dyes with explanation of technical principles involved. In dealing with the subject of factory practice some attention must be given to necessary theoretical and research matters, but it is not intended in this volume to present the more abstract chemistry of the azo dyes as a class. A factory process is merely a routine based upon theoretical and experimental considerations. The soundness of chemistry indispensable in theoretical and research work must be inherent in factory processes, but, apart from chemistry, economy in regard to labor and materials and conformation to the limitations of the short working day becomes of paramount importance. A lay belief somewhat generally accepted attributes an indefinable, mysterious elusiveness to the work of dyestuff production. Such belief, while serious enough in the stubbornness with which it persists, is in no way justified. Similarly to other large industries, success in dyestuff manufacturing depends upon capital, organization and hard work. The advantage possessed, elsewhere than in America, due to earlier participation in the industry, has been largely compensated by economic and circumstantial factors affecting the industry here.

Do You Use Your Plant Newspaper? C. J. Tagliabue Manufacturing Company, Brooklyn, N. Y.

This is the title of an interesting new booklet published by the makers of Tag industrial recording and controlling thermometers. The "plant newspaper," it is explained, is the recording thermometer, which keeps an accurate record of temperature fluctuations in any process and makes possible a check-up on men, methods and machinery. An example is given to show the practical value of the "plant newspaper" in accurate processing recording, the example being the story of a dyeing process during the course of one day, when the recording thermometer indicated a rise and fall of temperature at various times during the day, for several causes, the chief of which in this particular case was steam trouble. In explaining the importance of getting out a dependable "plant newspaper" the construction and operation of the Tag recording thermometer is

described in detail. A very interesting story is told of tests to which the Tag recorder was submitted to determine its accuracy under extreme conditions.

Various industries are cited in which an accurate "plant newspaper" plays an important part in efficient processing of materials ranging from bread and sugar to coal tar and automobiles. Types of Tag recorders for different purposes are shown and briefly described, and the numerous details of construction explained to show the importance of big "little things" in temperature recording apparatus.

The story is entertainingly presented and should prove generally instructive to all who are responsible for processes involving temperature control. It will be sent on request to the C. J. Tagliabue Manufacturing Company.

U. S. Government Specifications for Textile Materials (Methods of Physical and Chemical Tests).

A Comparative Study of Paper Fillers. By Merle B. Shaw and George W. Bicking.

Research Associates at the Bureau of Standards.

Publications of the Department of Commerce. Bureau of Standards.

So much destructive criticism has been heard about the Government in business and so much emphasis laid upon the economic evils of such activities that Governmental co-operation with business or with industry has come to be regarded in some quarters in an extremely unfavorable light. The critics who have brought infamy upon the interrelation of business and government unfortunately fail to distinguish between the good and bad features of this co-operation and as a result much that is noteworthy goes unpraised.

The work of the Bureau of Standards under the direct supervision of the Department of Commerce, which in turn is headed by that energetic exponent of standardization and conservation, Herbert Hoover, certainly deserves more complimentary mention than it ordinarily receives in the trade press. Not alone is the Bureau's extensive activities benefiting industry of the present; its publications, recording valuable technical data on numerous industrial operations, form a source of scientific and industrial information that is almost encyclopedic in scope, and to this the industry of the future can turn as a definite starting point on which to base research into any particular field of industrial processing.

The first two pamphlets listed above are examples of the kind of information made available to industry by the research work now going on at the Bureau of Standards. The first, giving general specifications for textile materials, contains methods of chemical and physical tests that were prepared for use in making determinations on the requirements specified in textile specifications promulgated by the Federal Specifications Board in order that variations introduced by different test methods may be eliminated. Although these methods are not intended to include all the textile test methods in use in the textile industry, they should form valuable data for textile chemists and technologists now engaged in working out tests for fiber identification, breaking strength, atmospheric conditions, weight, etc.

The second, describing the study of paper fillers, while less interesting to the textile industry, is of unquestionable value to the chemist in the paper mill. The tests described were made in the semi-commercial paper mill of the bureau. Commercial paper fillers, including abestine, talc, clay, crown filler and gypsum, were studied to determine their comparative paper making values. The paper produced was tested for weight, strength, color, capacity, finish, degree sized and filler retention.

For all industrial organizations engaged in, or formulating plans for industrial research, the pamphlet, "Research Associates at the Bureau of Standards," is a concise guide to efficient research planning. This circular gives a brief story of the origin and present status of the research associate plan which has recently grown notably both in magnitude and variety of fields. Examples are given of actual cases with a brief account of the research problems. Some published results are listed by title and citation to place of publication. A list of associates with names of sustaining organizations and the problems under investigation are given. The actions of Congress which authorized the opening up of the bureau's facilities for study and research are quoted in full. Research in progress at the bureau ranges from fundamental science to the most practical application in industry.

PRATT TECH NEWS ISSUED

The first number of Pratt Tech News has been issued. It is the official organ of the Alumni Associations of the School of Science and Technology of Pratt Institute, Brooklyn. An introductory note explains that it is "a syncopated quarterly" published December, March and June, but not September. It is edited by M. F. Behar, M '09, assisted by members of the Mechanical, Electrical and Chemical Alumni Associations. The contents of the first issue include a sprightly "write-up" of the Mechanical Alumni's annual dinner and one of the Chemists' annual dinner. An interesting note tells of the functions of the S & T Employment Service. Details are given in another article about the new Engineering Building presented to the School of Science and Technology by the trustees of Pratt Institute. Separate departments under the headings of Electricana, Chemicana and Mechanicana are devoted to the news of the numerous activities of the alumni forming the association. There is a department for athletics and an editorial explaining the policy of the News. The paper is well printed and written throughout in a sparkling style that augurs well for its future popularity.

The Reduction Products of Azo Dyes

Part XII

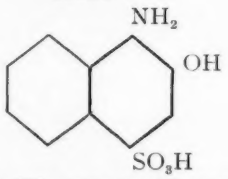
By WALTER C. HOLMES

Color Laboratory, Bureau of Chemistry

[EDITOR'S NOTE.—*The most practical and effective method for the identification of azo dyes consists in the isolation and identification of the products which they yield on reduction. This method finds less application than it might or should, partly because some of these products have never been isolated and investigated, and partly because much of the data which has been obtained in regard to such reduction products is greatly scattered and very difficult to locate.*

Mr. Holmes has made a search for all the available information on such reduction products, and this series contains a digest of his results with a systematic listing of the reduction products of the azo dyes published in the Colour Index, together with the available data on such properties and reactions as would be of service in their identification.]

No. 135.—1-AMINO-2-NAPHTHOL-4-SULFONIC ACID



$C_{10}H_9NO_4S$; Mol. Wt. 239.19; (C, 50.2%; H, 3.8%; N, 5.9%; O, 26.8%; S, 13.4%).

Derived from C. I. Nos. 74, 201, 202 and 652.

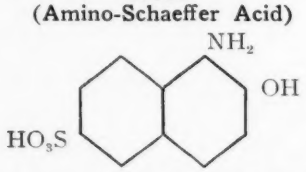
White cryst. pdr. (also described as yellow needles). Practically insol. in cold H_2O and only very sp. sol. in hot H_2O. The *Na salt* (needles) is sp. sol. in hot H_2O. Sols. in alkalies are colored a transitory deep green. Alkaline solutions are oxidized in the air and when warmed yield a brown dye which dissolves in hot H_2O with a green color.

"Best characterized by conversion into the reactive *β-naphthoquinone sulfonic acid* by the action of HN_3" (Green). See under No. 132.

With phenylhydrazine and bisulfite it gives a deep yellow sol. and an intensely yellow solid reaction product.

Diazotized in the presence of copper sulfate it gives a green-yellow cryst. *diazo comp.* (oxide). Coupled with *resorcin* in alk. sol. it gives a violet-black dye.

No. 136.—1-AMINO-2-NAPHTHOL-6-SULFONIC ACID (Amino-Schaeffer Acid)



$C_{10}H_9NO_4S$; Mol. Wt. 239.19; (C, 50.2%; H, 3.8%; N, 5.9%; O, 26.8%; S, 13.4%).

Derived from C. I. Nos. 5, 26, 63, 78, 87, 132, 182, 215, 226, 228, 261, 263, 269, 276, 285, 293, 298, (304), 316, 321, 337, 344 and 389.

White or grey-white needles or prisms. Sparingly sol. in cold H_2O and readily so in hot H_2O. Aqueous solutions soon turn brown in the air (more rapidly if alkalies are added), and are turned violet by HCl. [An ammoniacal sol. on filter paper is described as giving a brown color, yielding a lilac spot with HCl which at once becomes pink.] Very diffic. sol. in alc.

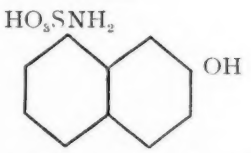
In the presence of sod. acetate it gives a red-violet dye with tetrazostilbene disulfonic acid which is converted into a blue dye by HCl. With diazobenzene-sulfonic acid it gives a fuchsin-red dye, turned bluer and brighter by HCl.

Acid oxidation yields *β-naphthoquinone sulfonic acid.*

No reactions are obtained with $FeCl_3$ or nitrous acid and no dye on heating with nitrosodimethylaniline hydrochloride.

The *sodium salt* ($+2\frac{1}{2}H_2O$) is readily oxidized in the air, particularly in alk. sols., and is used as a developer under the name "Eiconogen."

No. 137.—1-AMINO-2-NAPHTHOL-8-SULFONIC ACID



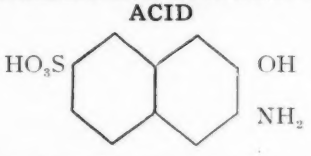
$C_{10}H_9NO_4S$; Mol. Wt. 239.19; (C, 50.2%; H, 3.8%; N, 5.9%; O, 26.8%; S, 13.4%).

Derived from C. I. Nos. 183, 205, 277, 281, 286, 376, 385, 386, 391, 470 and 513.

Reddish microsc. leaflets. Very diffic. sol. in boiling H_2O. Dissolves readily in alkalies, the sols. turning orange-brown in the air. The ammoniacal sol. on filter paper develops a green-yellow color, deepening to red-brown, and on spotting with HCl the brown color is discharged, leaving a bright orange rim. $FeCl_3$ gives a yellow color. Diazo comps. give brown color and evolution of nitrogen but no dye formation.

On heating with nitrosodimethylaniline hydrochloride in 50 per cent Ac HO a characteristic violet dye is obtained, the aqueous sol. of which is turned red by NaOH.

No. 138.—3-AMINO-2-NAPHTHOL-7-SULFONIC ACID



$C_{10}H_9NO_4S$; Mol. Wt. 239.19; (C, 50.2%; H, 3.8%; N, 5.9%; O, 26.8%; S, 13.4%).

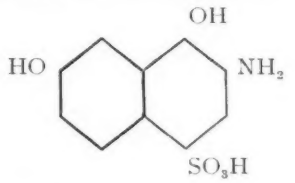
Derived from C. I. No. 206.

Needles, diffic. sol. in hot H_2O. (Sol. in 4,000 parts of H_2O at 15°.) The *Ba salt* is sparingly sol.

Sols. of the neutral salts fluoresce violet. They are turned dark blue by $FeCl_3$ (then discolored) and are turned yellow-brown by bleaching powder sol. (decolorized by excess).

With nitrous acid it gives a red-orange soluble *diazo comp.*

No. 139.—2-AMINO-1, 7-DIHYDROXYNAPHTHALENE-4-SULFONIC ACID

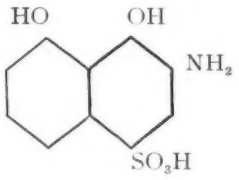


$C_{10}H_9SO_5S$; Mol. Wt. 255.15; (C, 47.0%; H, 3.6%; N, 5.5%; O, 31.3%; S, 12.6%).

Derived from C. I. Nos. 506 and 507.

Apparently no data are available on this compound.

No. 140.—2-AMINO-1, 8-DIHYDROXYNAPHTHALENE-4-SULFONIC ACID

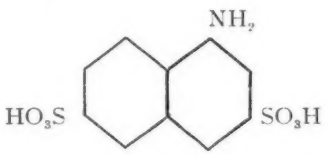


$C_{10}H_9NO_5S$; Mol. Wt. 255.19; (C, 47.0%; H, 3.6%; N, 5.5%; O, 31.3%; S, 12.6%).

Derived from C. I. Nos. 59, 66, 153, 255, 271, 295, 302, 509, 568 and 579.

Apparently no data are available on this compound.

No. 141.—1-NAPHTHYLAMINE-3, 6-DISULFONIC ACID



$C_{10}H_9NO_6S_2$; Mol. Wt. 303.25; (C, 39.6%; H, 3.0%; N, 4.6%; O, 31.7%; S, 21.1%).

Derived from C. I. Nos. 309, 310, 311 (Naphthol Black 2B, Lev.) and 320.

Small needles, readily sol. in H_2O. The salts with alkalies and alkaline earths are also readily sol.

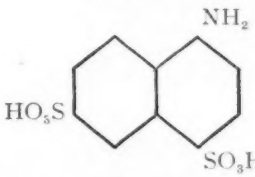
By treatment with sod. amalgam *α-naphthylamine* is obtained.

By heating with three parts of water at 180° it gives *α-naphthol-3, 6-disulfonic acid.*

It may be converted into *α-chlornaphthalene-3, 6- disulfonyl chloride,* mpt. 114° (or 127°), and into *1, 3, 6-trichlornaphthalene,* mpt. 80.5°.

It is converted into the sparingly sol. *1, 3-diaminonaphthalene-6-sulfonic acid* by NH_3 at 180°, and into the 1, 3-diphenylamino deriv. by aniline at 150-60°.

No. 142.—1-NAPHTHYLAMINE-4, 6-DISULFONIC ACID



$C_{10}H_9NO_6S_2$; Mol. Wt. 303.25; (C, 39.6%; H, 3.0%; N, 4.6%; O, 31.7%; S, 21.1%).

Derived from C. I. Nos. 309, 310 and 311.

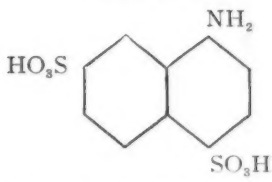
Needles, readily sol. in hot H_2O, less sol. in cold. The neutral *Na salt* is readily sol. and the acid Na salt (needles) dissolves in 6 parts H_2O at 20°. The *Ca salt* (needles) is sol. in H_2O and in 85% alc. but is insol. in 96% alc.

Alkaline fusion at 180-200° yields *5-amino-2-naphthol-8-sulfonic acid,* and at 200-220° *1, 6-dihydroxynaphthalene-4-sulfonic acid.*

It may be converted into *α-chlornaphthalene-4, 6-disulfonyl chloride,* mpt. 126-7°, and into *1, 4, 6-trichlornaphthalene,* mpt. 66° (and 56°).

With aniline at 180° it yields *phenyl-α-naphthylamine 6-sulfonic acid.*

No. 143.—1-NAPHTHYLAMINE-4, 7-DISULFONIC ACID



$C_{10}H_9NO_6S_2$; Mol. Wt. 303.25; (C, 39.6%; H, 3.0%; N, 4.6%; O, 31.7%; S, 21.1%).

Derived from C. I. Nos. 309, 310 and 311.

Small needles. Sols. of the acid and its salts fluoresce blue.

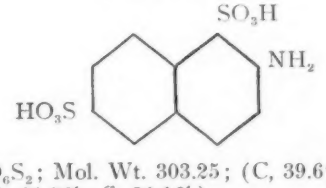
The normal sodium salt crystallizes with $3H_2O$ and is readily sol. The acid sodium salt is sol. in 140 parts H_2O at 20° or 20 parts at the bpt. The calcium salt is sp. sol. in H_2O. The latter two salts are nearly insol. in 85% alc.

On diazotization and boiling with dil. HNO_3 it yields Naphthol Yellow S.

It may be converted into 1-chlornaphthalene-4, 7-disulfonyl chloride, mpt. 107° and into 1, 4, 7-trichlornaphthalene.

Heated with aniline it yields phenyl-1-naphthylamine-7-sulfonic acid.

No. 144.—2-NAPHTHYLAMINE-1, 6-DISULFONIC ACID



$C_{10}H_9NO_6S_2$; Mol. Wt. 303.25; (C, 39.6%; H, 3.0%; N, 4.6%; O, 31.7%; S, 21.1%).

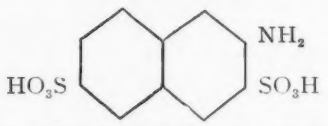
Derived from C. I. No. 200.

Small needles, readily sol. in H_2O, diffic. sol. in alc.

The neutral alkali salts are very sol. but the acid alkali salts are only sparingly so. Dilute sols. of the acid and acid salts fluoresce blue (weakly).

It may be converted into β-chlornaphthalene-1, 6-disulfonyl chloride, mpt. 124.5°, and into 1, 2, 6-trichlornaphthalene, mpt. 92.5°.

No. 145.—2-NAPHTHYLAMINE-3, 6-DISULFONIC ACID



$C_{10}H_9NO_6S_2$; Mol. Wt. 303.25; (C, 39.6%; H, 3.0%; N, 4.6%; O, 31.7%; S, 21.1%).

Derived from C. I. No. Nos. 198 and 199.

It gives an orange color with chlorinated pyridine.

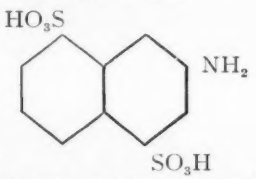
It may be converted into β-chlornaphthalene-3, 6-disulfonyl chloride, mpt. 165°, and into 2, 3, 6-trichlornaphthalene, mpt. 91°.

On alkaline fusion at 230-50° it yields 3-amino-2-naphthol-7-sulfonic acid (see No. 138).

Its diazo comp. forms sparingly sol. small yellow needles.

It gives a hydrazine comp. which yields naphthalene-2, 7-disulfonic acid on heating with copper sulfate.

No. 146.—2-NAPHTHYLAMINE-4, 8-DISULFONIC ACID



$C_{10}H_9NO_6S_2$; Mol. Wt. 303.25; (C, 39.6%; H, 3.0%; N, 4.6%; O, 31.7%; S, 21.1%).

Derived from C. I. No. 534.

Concentric grouped prisms. Sp. sol. in moderately conc. H_2SO_4. Alk. sols. fluoresce deep blue. It gives an intense red color and pptte. with chlorinated pyridine.

The acid Ba salt (needles) is sp. sol. in H_2O, the acid Na salt (needles) sp. sol. in alc.

The acid does not couple with diazotized bases.

It yields β-naphthol-4-sulfonic acid with 10% H_2SO_4 at 170-185° and 2-amino-4-naphthol-8-sulfonic acid with caustic potash at 215°.

Heated with aniline and aniline hydrochloride at 150-170° it yields 1, 3-diphenylamino naphthalene-5-sulfonic acid.

INDIGO DYE TRADE OF FOOCHOW, CHINA

While the net imports and export trade of the port of Foochow fell off but 12 per cent in 1925 as compared with 1924, the Indigo imports declined 50 per cent, and importations of gray shirtings for the dyeing of which indigo is used, decreased 34 per cent, a very definite indication of the decreased purchasing power of the people.

It is rather interesting to note that although the imports of indigoes fell off so strikingly in 1925, as compared with 1924, total imports were still in excess of those for the last pre-war year, 1913, when 516,800 pounds of foreign indigoes and 8,400 pounds of native indigoes were imported into Foochow, and far in excess of the last year of the Great War, when no foreign indigoes entered this market and but 92,000 pounds of native. Prior to the Great War the dye trade in China was a virtual German monopoly. During the war the trade was lost and it was not until 1919, the year following the war, that indigoes from other countries were in a position to enter the market. In that year 16,533 pounds of foreign indigoes, mostly American, were imported into Foochow, as over against 8,375 pounds of native indigoes.

Beginning with 1920, Germany fast regained much of her former indigo trade in this port, due to excellence of her product and favorable exchange. American dyes, which were now on a par in quality with the German, held their own ground very well, however, considering Germany's more favorable marketing conditions due to exchange. In 1925 the share of each country competing for the indigo business is estimated as follows: Germany, 50 per cent; American, 30 per cent; Switzerland, 12 per cent, and Great Britain, 8 per cent. Importations of native liquid indigo, which comes from Swatow chiefly, amounted to about 5 per cent of the imports from abroad.

The local market is accustomed to indigo 20 per cent paste. The Germans have introduced the 50 per cent paste, put up in quarter and half barrels, but thus far without any pronounced sale. Prior to 1925, the Foochow Maritime Customs did not classify indigo importations according to paste content, but the figures for 1925 show that of a total of 491,333 pounds of foreign artificial indigoes imported, only 9,600 pounds were 50 per cent paste. There was no "indigo white" imported.

DISSENSION ON DYE TARIFF QUESTION IN JAPAN

At a recent meeting in Osaka, Japan, of a special committee on the Tariff Revision bill, Mr. Okumura pointed out the inferior quality of Japanese dyestuffs, and blamed the Government for putting too rigorous restrictions on the importation of foseign goods.

Mr. Miyauchi, director of the industry bureau, said at present restrictions on importation were put on German manufactures only, though the authorities were considering the application of the license system in regard to dyestuffs imported from other countries. In Germany dyestuffs were manufactured so cheaply that it was impossible for the Japanese dyestuff industry to be adequately protected by means of the tariff only. The authorities were ready to prevent dumping by the law for the control of dumping, but as German goods were usually imported in small quantities, there was difficulty in deciding whether they were really designed for dumping. The authorities went upon the principle of restricting

the importation of dyestuffs of such kinds as could be produced in this country or for which domestic goods could be substituted. He believed that with the development of the domestic industry there would be a fall in price. The home manufacture of dyestuffs must be encouraged, in view of the military sense. Subsidies were already granted but this was not enough for the encouragement of the industry, the director said, and protection must be afforded by tariff.

ANILINE DYES IN SWITZERLAND

Notwithstanding the import restrictions and high customs duties levied by many countries upon dyestuffs, the dye manufacturers of Basel were able to slightly increase their exports during the past year. The exports for 1925 amounted to 4,939,084 kilos, in comparison with 4,659,100 kilos in 1924. In spite of this increase of 279,984 kilos, however, the values decreased from 52,698,000 francs in 1924 to 52,130,426 francs in 1925, because of the general lowering of prices of all aniline colors during the year, owing to keen competition from other countries.

For several years, according to information from Consul C. M. Hitch of Basle, the German market has been closed to Basle's dye producers, but during the past year, under arrangements effected between the Swiss and German governments, the import restrictions were relaxed to a certain extent. This was of material assistance to the Swiss dye producers, as they were again in a position to supply their German pre-war customers, and the results during the past year were very satisfactory.

The British import restrictions of aniline dyes have prevented the Basle manufacturers from increasing their exports of dyestuffs to that country. Whether the financial reconstruction and the general reorganization of the British Dyestuffs Corporation will have any influence on the English dyestuff market is problematical.

There was a heavy decrease in the exports of dyes to France, which is somewhat attributable to the French rate of exchange. The French textile mills are well employed, and if there is any improvement in the rate of exchange there will unquestionably be a large increase in the exports of aniline dyes to that country.

The losses sustained by Swiss dye producers in some of the markets of the world have been partially recouped by the large increase in exports to the United States, which in 1925 were more than double those for the previous year, as follows: 1,348,550 pounds, valued at $1,579,722, in 1925, as against 634,594 pounds, worth $791,686, in 1924.

MANUFACTURE OF COAL TAR PRODUCTS IN MEXICO

The erection during 1924 of a by-products plant at Rosita, Coahuila, introduced the manufacture of coal tar products in that section in connection with coal and coke operations. Because of the apparent demand which has existed for the product of this plant, it is understood the other coal operators in the Sabinas coal basin are considering installations for the manufacture of coal tar products.

During 1925, the first year of local production, the total quantity of by-products extracted was valued at about $241,000, as follows: Benzol, $83,000; coal-tar oil, $29,000; creosote oil, $57,000; ammonium sulphate, $72,000.

DU PONT ANNOUNCES BLACK FOR HALF-SILK

To meet the demand for a direct black for half-silk, the Dyestuffs Department of E. I. du Pont de Nemours & Co. are now offering to the trade Pontamine Black HS. On unions of cotton and silk it is said to give uniform, full shades and is described as particularly beautiful when treated with formaldehyde. When aftertreated with formaldehyde, according to the announcement, it is very fast to washing. It also it said to possess very good fastness to perspiration. The shade is claimed to be very bloomy and on cotton and silk to dye the same depth and tone. Its resistance to crocking is also given as entirely satisfactory.

NEWPORT ANTHRENE JADE GREEN SUPRA

Described as the most brilliant type of vat green now produced, Newport Anthrene Jade Green Supra is shown in a variety of shades on cotton, rayon and silk swatches attached to a leaflet recently issued by Newport Chemical Works.

This color, it is said, is easily reduced, levels well and is suitable for all types of machines either as a self-color or in combination with other vat dyestuffs for the production of a wide range of shades. Its fastness to all the usual color-destroying influences is described as very excellent. It is particularly well adapted for printing cotton, silk and rayon. The leaflet gives its fastness properties and describes at some length its application, under the headings, Preparation of Stock Vat, Dyeing Procedure and Oxidation and Finishing.

FISKDALE MILLS SOLD

In accordance with plans recently noted, and acting in the capacity of co-trustee in bankruptcy, Warren S. Shepard, vice-president of the Worcester Bank & Trust Company, Worcester, Mass., has sold under a conditional bill of sale the mills of the Fiskdale Finishing Company, of Fiskdale, Mass., to Malcolm R. Lovell, of New York. The price is given as $125,000 and the date for the final transfer of the property is May 4. The Fiskdale Finishing Company at one time employed 400 hands. In November, 1924, an involuntary petition in bankruptcy was filed by creditors, and the mills have been idle. It is expected they will be put in operation soon after the sale is completed.

Technical Notes from Foreign Sources

Printing or Stenciling Acetyl Cellulose

Printed colored effects fast to rubbing are obtained on cellulose acetate by means of printing pastes which contain specially solubilized coloring matters or other dyestuffs and a substance which is capable of exerting a swelling or solvent action on cellulose acetate. Suitable swelling agents include the salts of sulphonic acids, of benzene, naphthalene and anthracene, and substituted derivatives such as phenol, naphthol, aminonaphtholsulphonic acids, and particularly a thiocyanate of ammonium or an alkali metal (for alkalies or neutral printing pastes) and zinc nitrate or chloride (for acidic printing pastes).

For example, woven or knitted cellulose acetate silk is printed with bluish-red effects by means of a printing paste which contains 40 grams of a color paste (prepared by heating 4 grams of 2:4-dinitrobenzene-1-azodimethyl-aniline, 12 c.c. of water and 24 grams of 70 per cent sodium ricinoleate until dispersion of the coloring matter is complete), 5 grams of soda ash, 20 grams of ammoniumthiocyanate, 40 grams of water and 295 grams of a thickening (prepared by boiling for ten minutes a mixture containing 600 grams of dark British gum, 600 grams of a 50 per cent aqueous solution of gum arabic and 800 grams of water). After printing, the fabric is dried (preferably by means of hot air), steamed for fifteen to twenty minutes in dry steam, soaped lightly at 60 deg. Cent., washed and dried. (British Patent No. 244,143.)

Dyeing of Vistra

Vistra is a special type of viscose artificial silken fiber. It is dyed easily with substantive coloring matters. Sulphur colors can also be employed for this purpose. The vat dyes can be used on this fiber, except where it is interwoven with other textile fibers. Mixed fabrics containing vistra fibers can be dyed only with semi-wool coloring matters, while the basic dyes are suitable for all vistra products. When light shades are being dyed, the coloring matters are absorbed without the need of mordanting with tartar emetic and tannin. When sulphur and vat coloring matters are used for this purpose, it is necessary to add as little alkali as possible to the color bath. The preliminary treatment for vistra products consists in wetting down the fiber with a 1 per cent soda solution at 15 deg. Cent. (Deut. Wollen-Gew., 1925, p. 887.)

Machine-Dyeing of Warp Yarns

An interesting article on the machine-dyeing of warp and other yarns is published in Deutsche Faerber Zeitung, 1926, page 250.

In order to obtain a warp fiber which is perfectly uniformly colored throughout, it is necessary to dye the fibers on the beam, for dyeing the latter in the form of yarn or on spools will not give as good results. One other factor to be considered in this connection is that dyeing the warp threads on the beam is cheaper than on spools, for it is a much easier matter to load and unload the machine in which the dyeing is carried out. Dyeing the yarn in the vat is the most expensive form of coloring cotton yarns.

The character of the water employed in the dyeing process is of particular importance in machine-dyeing. Water containing considerable calcium salts must first be softened before being used. Soda is commonly used for this purpose, the lime salts being removed as precipitates. Only coloring matters which are particularly suited for machine-dyeing should be employed. Special attention must be paid to see that the coloring matter is properly dissolved. There are certain precautions which must be taken in dyeing the fibers in certain shades, and these are given below.

For example, in producing the gray shades which are stylish at the present time, both when the dyeing is carried out on the beam as well as on the spool of thread, a fresh dye liquor must be employed each time the process is carried out, and the water employed for this purpose must be softened. It often happens that while the great majority of the dyeings are perfectly satisfactory and the colors match very well, there will nevertheless creep in at times a sort of brownish shade. In an investigation made to determine the cause of this, it was found that the quality of the water varied. This was found to be the cause of the difference in the shades.

In dyeing light tones, during which process the temperature is maintained at a point between 50 and 70 deg. Fahr., the material must first be boiled, and this must be done no matter how the dyeing is carried out; that is, either on the beam, on the spool or in the loose form. The preliminary boiling is generally effected in the dyeing machine itself, and the duration of the boiling is from fifteen to twenty minutes. Thereafter the material is washed with cold water. In carrying out the actual dyeing process it has been found advisable to use from 2 to 3 grams of the coloring matter to 1 kg. of the material being dyed. The temperature is maintained at 50 deg. Cent. From 1 to 2 liters of the preparation known as Coloran K are employed in making up the dye liquor, as it has been found that this substance has a very potent effect in promoting the smoothness of the dyeing process.

Dyeings which require more than 6 grams of the coloring matter to 1 kg. of the dyed material must be carried out at the boiling temperature without it being

necessary to subject the material to a preliminary boiling. Here again good results are obtained by the addition of Coloran K.

Bleaching Textile Fibers

The textile fiber which is to be put through the bleaching process is dipped for a short time in a 1 to 2 per cent solution of hydrogen peroxide. Then the material is immediately freed from all excess bleach liquor, this being accomplished, for example, by wringing out the fibers, which are then allowed to remain quiescent. In this manner it is possible to obtain rapid and uniform bleaching of the fibers without injuring them in any manner. Colored yarns may also be bleached by this process, for during the operation an excess of bleach liquor is avoided and the hydrogen peroxide acts more rapidly on the natural impurities that are found in the textile fibers than on the coloring matters employed in dyeing. (German Patent No. 415,584.)

Preparing Starch Emulsions

The starch is first made into a slime with water and this slime treated with small amounts of acids or acid salts. The operation is preferably carried out at an elevated temperature. Then the entire mass is heated with the addition of alkali until the starch has been solubilized. Then the alkali is neutralized with acid, and the starch emulsion which is obtained in this manner can no longer be precipitated by means of basic salts. Such starch emulsions find use in laundries, sizing, calico printing and the like. (German Patent No. 408,523.)

Diphenylmethane Coloring Matters

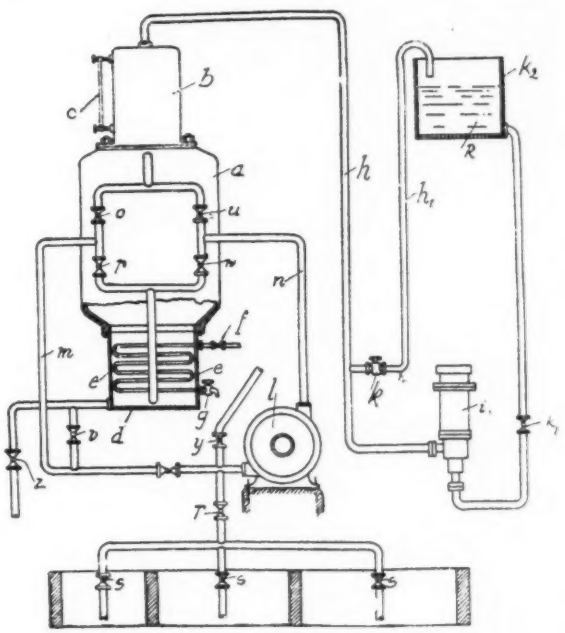
Diphenylmethane coloring matters are condensed with phenylmethylpyrazalone, beta-naphthol or nitromethane in aqueous solution and the leuco products are subsequently oxidized. For example, a coloring matter capable of yielding fluorescent shades fast to light on silk and cellulose acetate silk is obtained by condensing thiopyronine with phenylmethylpyrazalone in an aqueous solution of sodium hydroxide. Under similar conditions golden yellow (with green fluorescence) and red fluorescent coloring matters for silk and cellulose acetate silk are obtained from acridine orange and phenylmethylpyrazalone, and from thiopyronine and nitromethane, respectively. (French Patent No. 589,745.)

Coloring Matters from Peat

According to Austrian Patent No. 99,926, humic acids are precipitated by the addition of acids to the product that is obtained by digesting peat with a dilute solution of sodium carbonate containing sodium hydroxide or potassium hydroxide. These acids are then heated to a temperature of 200 deg. Cent. with the addition of alkali sulphides or polysulphides in the presence of salts of the heavy metals, such as copper, zinc and iron. The resulting coloring matter may be purified and its color strengthened by the introduction of nitro groups.

Bleaching with Oxygen and Ozone Liquors

In German Patent No. 421,906 there is described a process and apparatus for the bleaching of textile fibers with the aid of oxygen and ozone bleach liquors. The improvement in the operation consists in the increase in the pressure after the bleaching vessel has been filled, as well as the maintenance of the increased pressure in the bleaching apparatus during the further treatment of the textiles with the aid of a liquor under pressure.



As the figure shows, the pump (i) is used to pump the resist printing liquor through a pipe (k) from a container (k_2) and eventually into the bleaching vessel. By means of the overflow pipe (h) the pressure of liquid in the latter vessel can be regulated at will. After the bleaching kier has been filled with the textiles, the pump (l) is started and the liquor is pumped into the kier, the pressure being controlled by means of the pump (i). The dome (b) of the kier can be done away with in certain cases; the piping (n, m) is for circulating the liquor through the bleaching kier. The heating coil is seen at (e).

Leather Dyeing

Comparative dyeings on vegetable-tanned leather were made with different acid coloring matters without added acid or salts, and with the addition of sulphuric acid, acetic acid, sodium chloride, sodium sulphate, and sodium

sulphate and sulphuric acid, respectively. Acid coloring matters gave as good a color with acetic acid as with sulphuric acid, and in some cases fuller and more even shades. Sodium chloride reduced the color value of acid dyes on vegetable-tanned leather. Many acid coloring matters gave full shades without the addition of acid. Sodium sulphate had a similar action to sodium chloride. Sodium sulphate and sulphuric acid gave slightly paler shades than sulphuric acid alone. (Jour. Soc. Leather Trades Chemists, Vol. 9, pages 518 to 520.)

Common Faults in Cotton Goods

In the Journal of the Textile Institute, Vol. 6, pages 323 to 337, there is published an article which deals with the common faults found in cotton goods. It discusses the use of the microscope in determining these faults and indicates that this instrument is of special value in elucidating the causes of these faults. One chapter is devoted to a discussion of mercerization, and in it there is shown how the degree of penetration by the alkali and the efficiency of the tension employed may be judged from cross-sections of the material.

Easily Soluble Vat Dyestuffs

Preparations of vat coloring matters which are soluble in cold or warm water are obtained by mixing unreduced vat dyestuffs with a caustic soda, a hyposulphite and a salt of a sulphonic acid which is capable of acting as a dispersing agent; for example, sulphonic acids of unsaturated fatty acids, ligninsulphonic acid, sulphite cellulose waste lye, or water soluble carbohydrates such as glucose and dextrin. This can also be effected by the addition of suitable quantities of a hyposulphite and a caustic alkali to an aqueous solution of an alkali salt of a sulphonic acid which contains a vat coloring matter.

For example, a mixture containing 2-(4'-chloroanilido)-1:4-naphthaquinone, Monopole soap (twice sulphonated castor oils), and caustic soda is dried, and sodium hyposulphite is then added; or the mixture containing the coloring matter and caustic soda is warmed, filtered and mixed with caustic soda and sodium hyposulphite; or the coloring matter is mixed with molasses, a caustic alkali and sodium hyposulphite. (French Patent No. 589,914.)

Sizes for Artificial Silk

Sizing preparations for yarns or threads, particularly those of spun silk or artificial silk, comprise one or more lubricating agents, namely: none-drying oils, fats, waxes, or liquid or solid fatty acids, together with one or more resins, such as dammar resin or gum mastic. One or more soaps of fatty acids, including those of sodium, potassium, ammonium, but preferably those of calcium, magnesium, zinc or aluminum, may be added. The resin may be dissolved in benzol, toluol, xylol, oil of turpentine and the like with admixture of the lubricating agent; or emulsifying agents may be employed; or the materials may be melted together.

The following is given as an example: Gum mastic or dammar resin, 20 parts by weight; lard, 7 parts; xylene, 25 parts; with or without magnesium oleate, 1.5 parts. The preparation may be applied by dipping the yarn in hanks or during winding of the yarn; or it may be applied to artificial threads of cellulose esters or ether continuously with their production by the dry or evaporative spinning method, as described in British Patent No. 210,-266. The size may be removed by scouring with a soap solution with or without previous treatment with acid. (British Patent No. 244,979.)

Dyeing Cellulose Acetate

Cellulos acetate products are dyed by means of the substances that are obtained by condensing 1-chloro-2:4-dinitrobenzene-6-sulphonic acid or 1-chloro-2:6-dinitrobenzene-4-sulphonic acid or a salt of these acids with an aromatic amino or hydroxy compound. In an example, 1-chloro-a: 4-dinitro-benzene-6-sulphonate is dissolved in aqueous sodium acetate and aniline is run into the boiling liquor. The dyeing may be carried out by immersion of the cellulose acetate in an aqueous solution or suspension of the coloring matter and heating to about 75 deg. Cent. (British Patent No. 244,936.)

TWENTY-THIRD CONVENTION OF PHI PSI FRATERNITY

The twenty-third annual convention of the Phi Psi Fraternity, oldest textile school fraternity in America, closed with a banquet at the Hotel Westminster, Boston, on Saturday evening, April 17. About 500 were present, including representatives from its seven chapters, in Philadelphia, New Bedford, Fall River, Lowell, Raleigh, N. C., and Atlanta, Ga. Members of the alumni associations of Boston, New York, Chicago, Utica, Providence, Philadelphia and northern New Jersey were also present. John H. Grady, business manager of the fraternity quarterly, acted as toastmaster. The principal speaker of the evening was George P. Newell, mill agent of Washington, D. C.

At the afternoon session of the convention Arthur E. Snyder, of Boston, was elected president of the Phi Psi; Mortimer J. Farley, of Weston, secretary, and Harold H. Hart, of Wolfboro, N. H., editor of the quarterly. Arthur R. Thompson, of Charlotte, N. C., and Percival Theel, of Philadelphia, were re-elected vice-president and treasurer, respectively.

Eta Chapter

R. I. Dalton, Southern agent of the Whitin Machine Works, and W. A. Erwin, Jr., of the Erwin Cotton Mills, Durham, N. C., have been elected members of Eta Chapter of the Phi Psi Textile Fraternity at the Textile School of the North Carolina State College.

Three textile students were also accepted as members. Following the initiation, the new members were guests at a banquet given by Eta Chapter.

Speakers at the banquet were Messrs. Dalton, Erwin, A. R. Thompson, Southern representative of Rohm &

Haas Company, grand vice-president of the Phi Psi Fraternity, Dean Thomas Nelson, Professor T. R. Hart and J. M. Currie.

The officers elected for next year are: J. F. Matheson, president, Cheraw, S. C.; M. C. Comer, vice-president, Greensboro, N. C., and J. C. Cobb, secretary and treasurer, Lancaster, S. C.

THE DYER'S SCHOOL OF EXPERIENCE

(*Continued from page* 290)

Manufacturing Company and got the Logwood and Hematine. Then, as we were not loading any silk in our mills, I had to procure some bichloride of tin and again asked our manager to get it for me from the chemical house we were doing business with, and again the manager got it from another source for reasons best known to himself, and when I got two gallons of the stuff, I got a bill for six dollars taken out of my pay. I made no complaints directly, but told someone about it. I also mentioned the fact that I was surprised that they should make me pay for chemicals that I told them would be used for experiments, when if I bought them in ten or hundred pound lots and said nothing about it, the firm would have paid for it without question. This was reported to the manager as I had intended it should and after that every time I ordered any dyes or chemicals in small quantities I was put through the third degree to explain what I wanted them for.

This is the encouragement I got from my employer when I was trying my best to make myself a valuable man for his benefit, using my newly acquired knowledge in testing chemicals for purity, soap, dyestuff, and taking home samples to be tested for lack of facilities in my place of business. I hope that there are not many employers in the country like this one, for progress would indeed be slow in the textile business.

I never succeeded in the object which started me on my study of chemistry. I got discouraged and felt unable to stand the expense of buying so many things, pieces of apparatus, chemicals, etc., that I needed. I could not attend any day or night school at that time and the family needed all the money I could make, so I devoted my study to the chemistry of dyeing.

Later I saw that mine was not an idle dream, for in a recent publication I read that cellulose is used just as I thought it could be used, for printing velvet designs on cheap materials.

DEVELOPMENT OF ITALY'S DYE INDUSTRY

The Fabbriche Italiane Materie Coloranti Bonnelli of Milan announces an increase of capital from 40,000,000 lire to 45,000,000 lire. The fiscal year 1924-25 closed with profits of 4,465,982 lire, which permitted the declaration of a dividend of 12 per cent. The company reports that all the intermediates used in the company's dyes are now manufactured in the firm's own plants. Special development has been attained in the production of sulphur black. It is further reported that the production of synthetic indigo has been undertaken.

S. R. DAVID ELECTED PRESIDENT OF THE DRYSALTERS CLUB

Sidney R. David, whose likeness appears below, president of S. R. David & Co., Inc., dyestuff dealers of Boston, Mass., was elected president of the Drysalters Club of that city at the annual meeting held April 26.

Mr. David is widely known in dyestuff circles. He was with Bayer & Co. for fourteen years, from 1898 until 1911, when he became New England manager for William Beckers & Co., which position he held until 1917, when he became general sales manager of

the National Aniline & Chemical Company, in New York City. This position he held only a little over a year, when he went into business for himself under the present title of S. R. David & Co., Inc.

The Drysalters Club of Boston is a unique organization of its kind in this country, and is the oldest organization of any type connected with the textile-chemical industry. Its presidents have been in every case men who are exceptionally well known in the dyestuff field, and election to this office is no small honor. Mr. David succeeded Harry R. Davies, of the Dyestuffs Corporation of America, who had been president for the past two years.

SPAIN STOPS DYE IMPORTS

By a royal order effective March 12, 1926, Spain has temporarily prohibited the importation of coal-tar intermediates and dyes other than synthetic indigo, according to Commercial Attache Cunningham, Madrid.

It is anticipated, however, that the domestic industry is not yet capable of satisfying the full requirements of the textile industry, and the vice-president of the Consejo de Economia Nacional will have power to authorize the importation of products classified under the prohibition when local production cannot meet the needs of the industry within the country, taking into consideration national production, consumption and prices. Importation permits may be secured under such circumstances when duly solicited from the vice-president of the Consejo de Economia Nacional, samples of the material it is desired to import always being submitted with the request, and permits secured before the arrival of the merchandise at a Spanish port.

The only Spanish firm of any importance manufacturing dyestuffs before the was was that of Vero Vidal, of Barcelona, which was then severely handicapped by German competition. During the war this concern and three other small manufacturers, making only a few colors, built up a profitable business and continued to expand their business after the war had ended, although they were again forced to meet foreign competition. In 1922 they combined to form the Sociedad Fabricacion de Colorantes y Explosives, Barcelona, with a capital of seven millions of pesetas, and paid their first dividend of 5 per cent in 1924.

The reasons given for the present order are: (1) The importance of the dye and explosive industries as a basis for national defense, because same can be readily converted into the service of the State in case of war; (2) the critical state of the dye and explosive industries at the present time necessitating the protection of the State against foreign competition, which can be regulated by a regimen of prohibition of imports arranged by special permits when necessary; (3) the law of April 22, 1922, authorizing the State Government to take these steps to protect Spanish industry against foreign dumping, or to prohibit the importation of merchandise from any country when extraordinary circumstances require.

A. C. S. PLANS CHEMICAL EXHIBIT SHOWING FIFTY YEARS' DEVELOPMENT

A commercial exhibit illustrating the developments in American chemical industry by representative chemical concerns will be one of the features of the fiftieth anniversary of the American Chemical Society to be celebrated in Philadelphia next September. The proposed exhibit was approved by the American Chemical Society at its recent meeting in Tulsa. Major Harry S. Kimberly was chosen to organize and supervise the undertaking.

Judging by the interest already shown in the fiftieth anniversary of the founding of the American Chemical Society, it will be the largest and most enthusiastic meeting the society has ever held. Chemists from many of the European and South American countries will also participate in the largest gathering of chemists ever held on the American continent.

The exhibit of representative commercial concerns showing the progress of various branches of chemical industry in the last fifty years will prove particularly attractive to those in attendance. This exhibit will be held in the gymnasium of the University of Pennsylvania, which is one of the group of buildings in which the society will hold its meeting.

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i. e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

TEXTILE CHEMIST

Position wanted as textile or research chemist in connection with a textile manufacturing concern. Have had training in a leading textile school and over ten years' practical experiences with print works in cotton finishing concerns. Address Box 336, American Dyestuff Reporter.

TEXTILE CHEMIST

Textile chemist desires responsible position. Has had fifteen years' experience in cotton yarn and cloth bleaching, dyeing and finishing plants. Wide knowledge of new artificial silk processing and fast color work, including vats and aniline black. Excellent references. Box 338, American Dyestuff Reporter.

CHEMIST

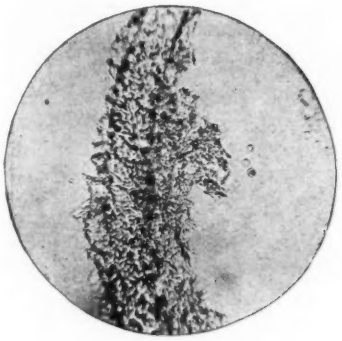
Chemist with technical and practical experience in the manufacture of softeners, oils, soaps and chemicals used in textile plants. Capable of assisting in control of production analysis and supervision over help. State complete record of education, experience and salary. Address Box 339, American Dyestuff Reporter.

PRINTING MACHINE

Wanted: Laboratory textile printing machine suitable for application of aniline dyes on piece goods in producing prints. Must be in good condition. Address Box 337, American Dyestuff Reporter.

DYEHOUSE SPACE TO LET

Ground floor space to let for silk dyer. 9,000 square feet. Will divide. Steam and power. L. N. Hartog, 214-24 East Twenty-second Street, New York City.



Photomicrographs of wool fibres. After scouring in raw water on the left, and in properly conditioned water, as on the right. The lime soap curds formed by raw water have nearly buried the fibre on the left.

How Unsuspected Impurities Get Into Your Water Supply

When you consider what a wonderful solvent water is and think how many different substances it travels over and through on the earth before it reaches your mill, it is not hard to realize that water supplies are constantly changing in character.

Before the water reaches you, it has come in contact with dead plants and leaves, soft rocks, limestones, many different minerals, and seasonal impurities of all sorts. Small wonder then that it can change under your very eyes without your noticing or suspecting any variation.

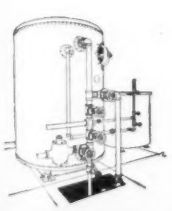
These unsuspected impurities are the source of serious textile manufacturing troubles and expenses. The photomicrographs shown above illustrate how harmful they are to textile fabrics. The left one shows a wool fibre taken from a faulty piece in a fabric that was scoured in raw water. The heavy coating of lime curds which destroyed the quality of this fabric is due to hidden impurities present in the water supply.

The right photomicrograph is of wool fibres from a fabric that was processed in this mill water after all the harmful impurities had been previously removed by Permutit water-conditioning apparatus. The noticeable cleanliness of the fibres is proof of the remarkable improvement properly conditioned water will make in the quality of yarns and fabrics.

The Mill Manager who sent these samples saved thousands of dollars by installing Permutit apparatus to condition his water supply before using it in his mill. He now consistently turns out yarns and fabrics of highest quality at a *lower production cost.*

His original ideas were obtained from our booklet, "Reducing Textile Costs and Troubles." It contains valuable suggestions, and practical solutions of water problems as effected in many of the leading textile plants in the country.

It is interesting reading for every textile man —write today for a free copy.



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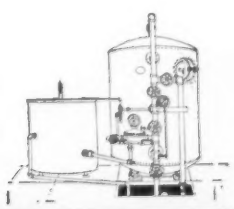

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ALL the Buddy Poppies are the actual handiwork of disabled and needy veterans. The entire proceeds from their sale are devoted to relief of war-disabled and to alleviate conditions of distress among ex-service men and their families occasioned by sickness or unemployment.

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And to Those Who Have None

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A Small Beam Dyeing Machine

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For the Dyeing of Your Samples, the Dyeing of Your Warp Stripes and the Working Out of Dyeing Problems.

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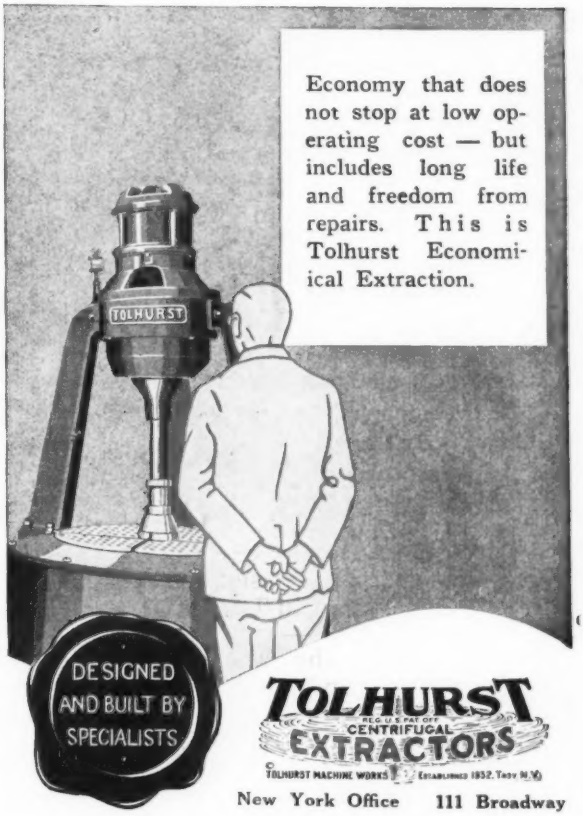

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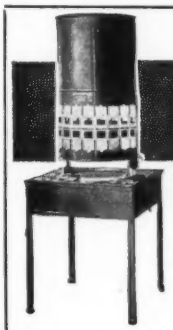

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Standardized Sunlight

"Faster Colors are the Order of the Day"

say the Newport Chemical Works, Inc. And they are certainly right.

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